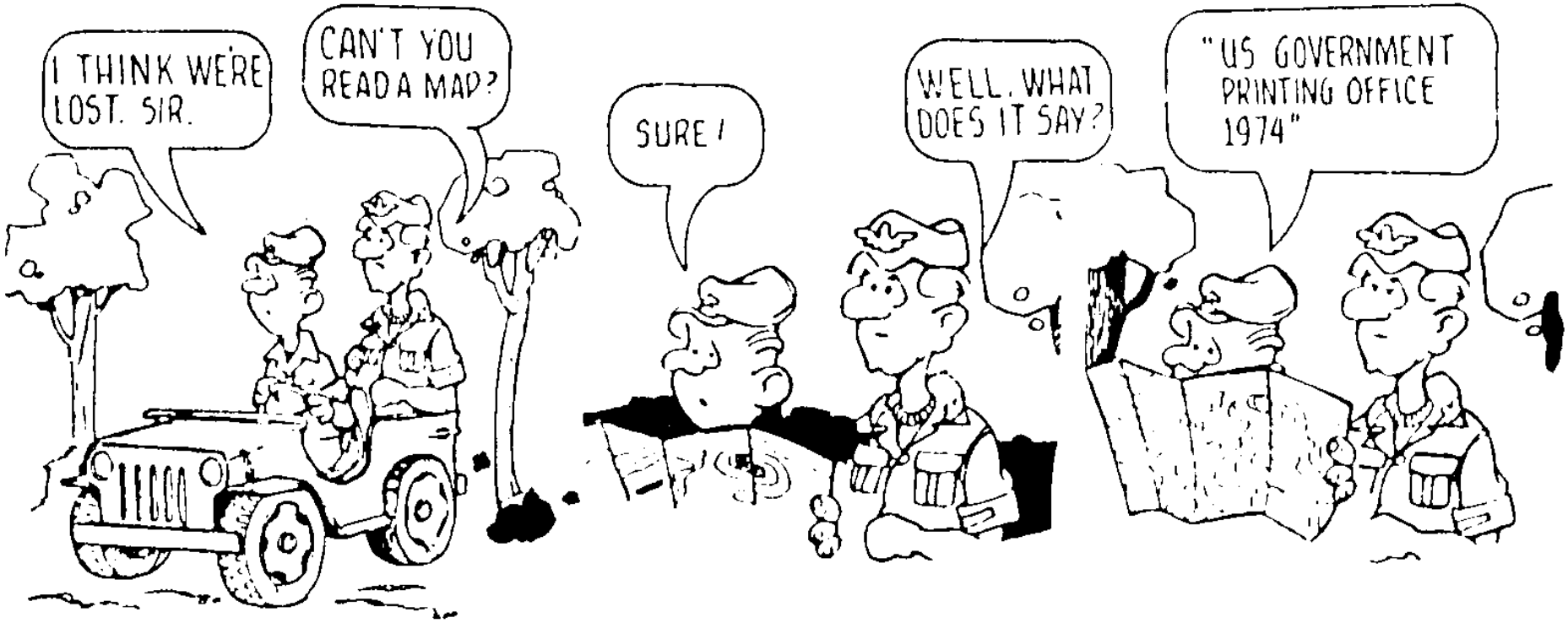
MAP READING



SSTC

All Army noncommissioned officers, as leaders, must be able to navigate from one point to another. The ability to find your way from one location to another on the ground by using a map and or a compass is necessary for conducting successful military operations. If you get lost in combat, you may run into the enemy and fail your mission. To keep from getting lost, you must be able to read a map and use a compass correctly while planning tactical movements,

AUTHOR: SFC NORMAN M. VANCE

ENABLING LEARNING OBJECTIVE

Given a military map, classify it by type and scale

Identify the marginal information

Identify the six basic colors

Locate an object on a military map using the military grid reference system within 10 meters

Given a military map, calculate the height, above sea level, of a specific point

Given a military map, using straight line and/or road distance methods, determine the distance from one point to another

SSTC

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WHAT IS A MAP?

A MAP IS A GEOGRAPHIC PREPRESENTATION OF A PORTION OF THE EARTH'S SURFACE DRAWN TO SCALE, AS SEEN FROM ABOVE. IT'S USES COLORS, SYMBOLS AND LABELS TO REPRESENT FEATURES FOUND ON THE GROUND.

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PURPOSE OF A MAP

A MAP PROVIDES INFORMATION ON THE EXSISTEN
THE LOCATION OF, AND THE DISTANCES BETWEEN
GROUND FEATURES, SUCH AS POPULATED PLACES
AND ROUTES OF TRAVEL AND COMMUNICATON.
THE MAP ALSO INDICATES VARIATIONS IN TERRAIN
HEIGHTS OF NATURAL FEATURES, AND THE EXTEN
OF VEGETATION COVER.

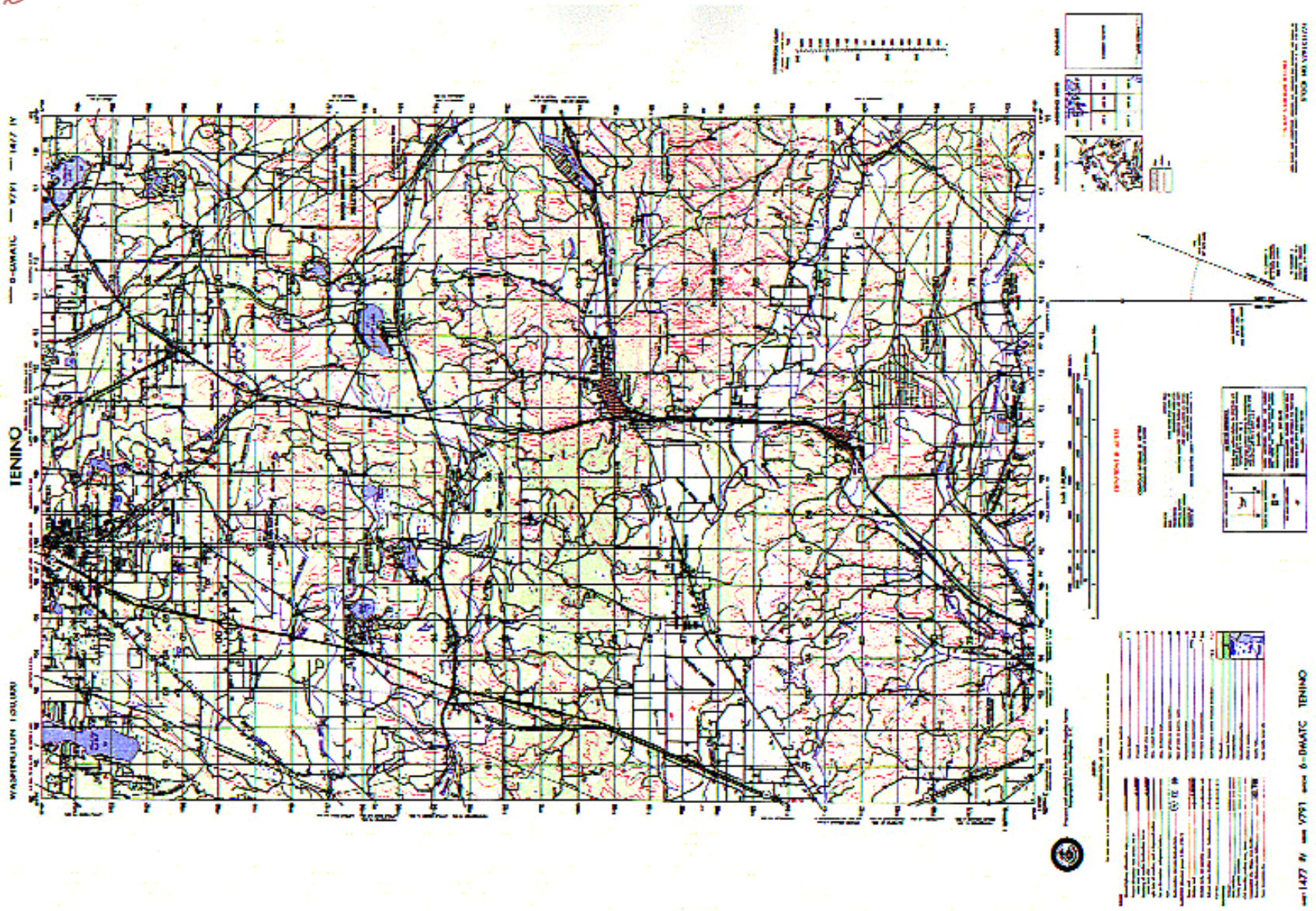
MAP SECURITY

- SPECIAL HANDLING (DOCUMENTS)
- INFORMATION OF MILITARY OPERATIONS
- MAP DESTRUCTION (METHODS)
- THIRD PARTY LIMITATIONS

MAP CARE

- PROTECTION FROM ELEMENTS
- TRANSPORTING
- CARE FOR LONGEVITY
- PENCIL VERSUS PEN

Topographic Map

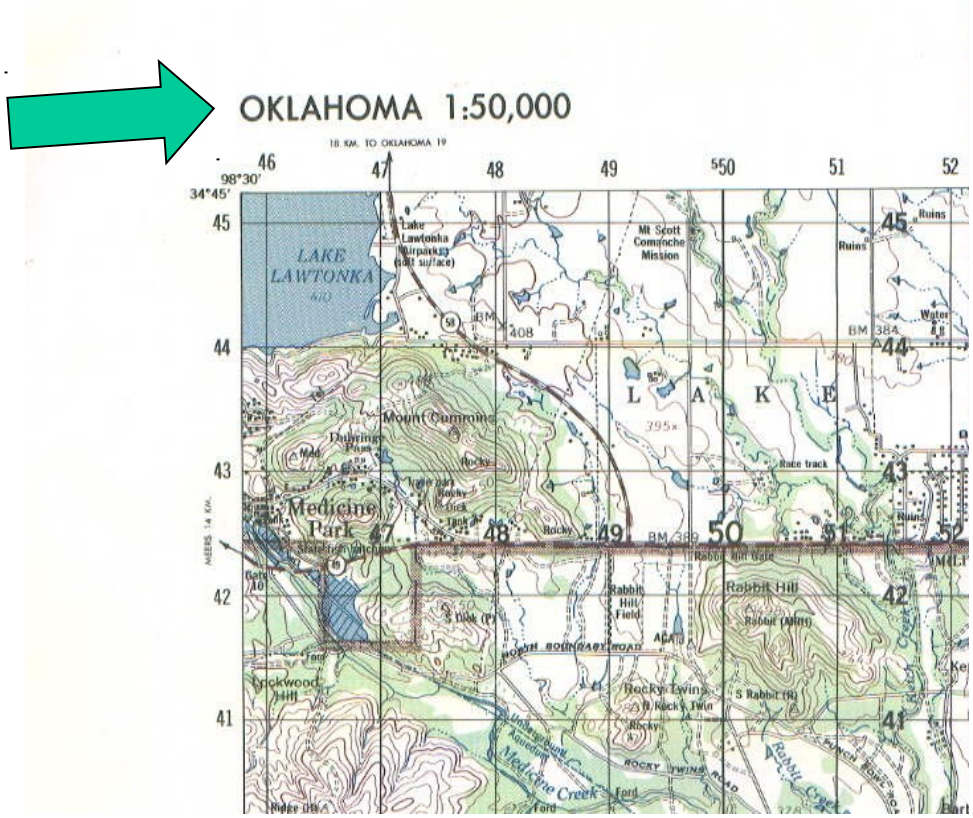


MARGINAL INFORMATION

Information and instructions placed along the border of the map are called marginal information. The marginal information contains:

- **Sheet Name**
- **Sheet Number**
- **Series Number**
- **Edition Number**
- **Contour Interval**
- **G-M angle**
- **Legend**
- **Scale**
- **Bar Scales**
- **Declination Diagram**
- **Grid Reference Box**
- **Adjoining Sheets Diagram**
- **Elevation Guide**
- **Index to Boundaries**

Series Name - The name given to the series is generally that o
a major political subdivision, such as a state within the United S
or a European nation. A map series usually includes a group of s
maps at the same scale and on the same sheet lines or format de
to cover a particular geographic area



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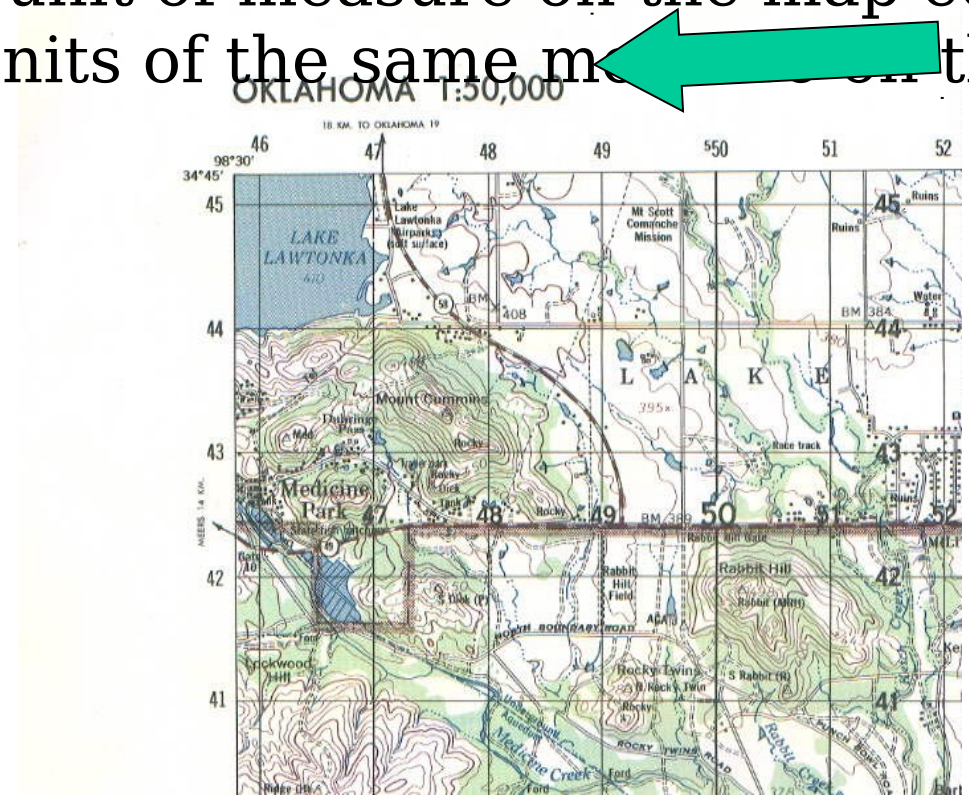
Scale - is a representative fraction that gives the ratio of a map distance to the corresponding distance on the earth's surface. For example, the scale note 1:50,000 indicates that one unit of measure on the map equals 50,000 units of the same m[illegible] the ground.



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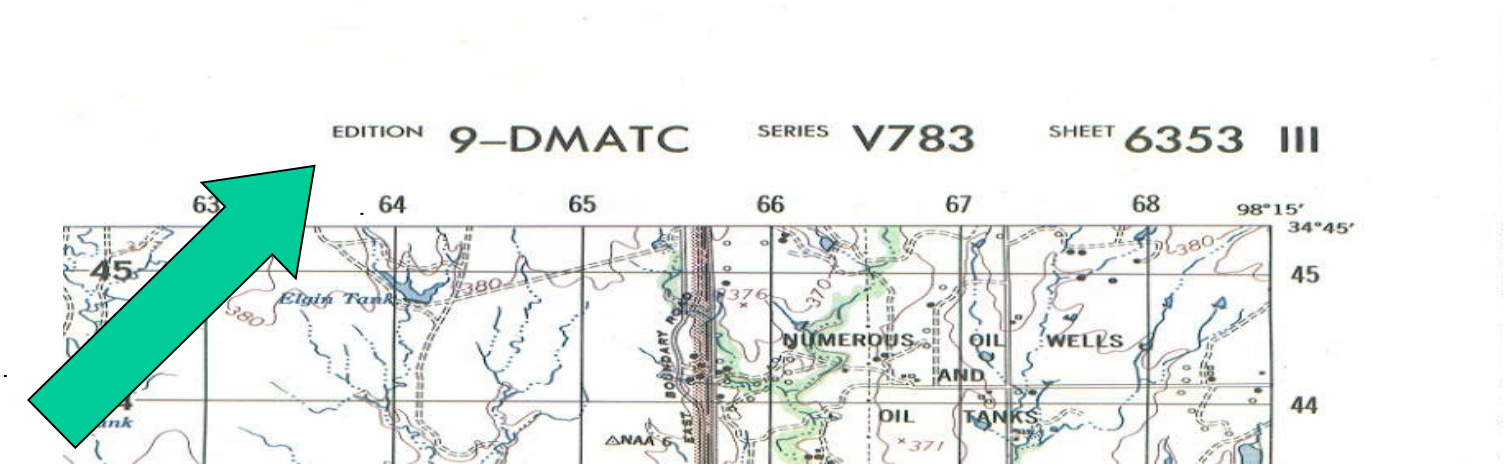
Sheet Name - The sheet name is found in bold print at the cente the top and in the lower left area of the map margin. A map is ger named for the largest settlement contained within the area covere the sheet, or for the largest natural feature located entirely within area at the time the map was drawn.

SSTC

Edition Number- are numbered consecutively; the highest numbe
sheet is the most recent. The map information date is found immedi
below the word "LEGEND" in the lower left margin of the map. This
date is important when determining how accurately the map data m
be expected to match what you will encounter on the ground.



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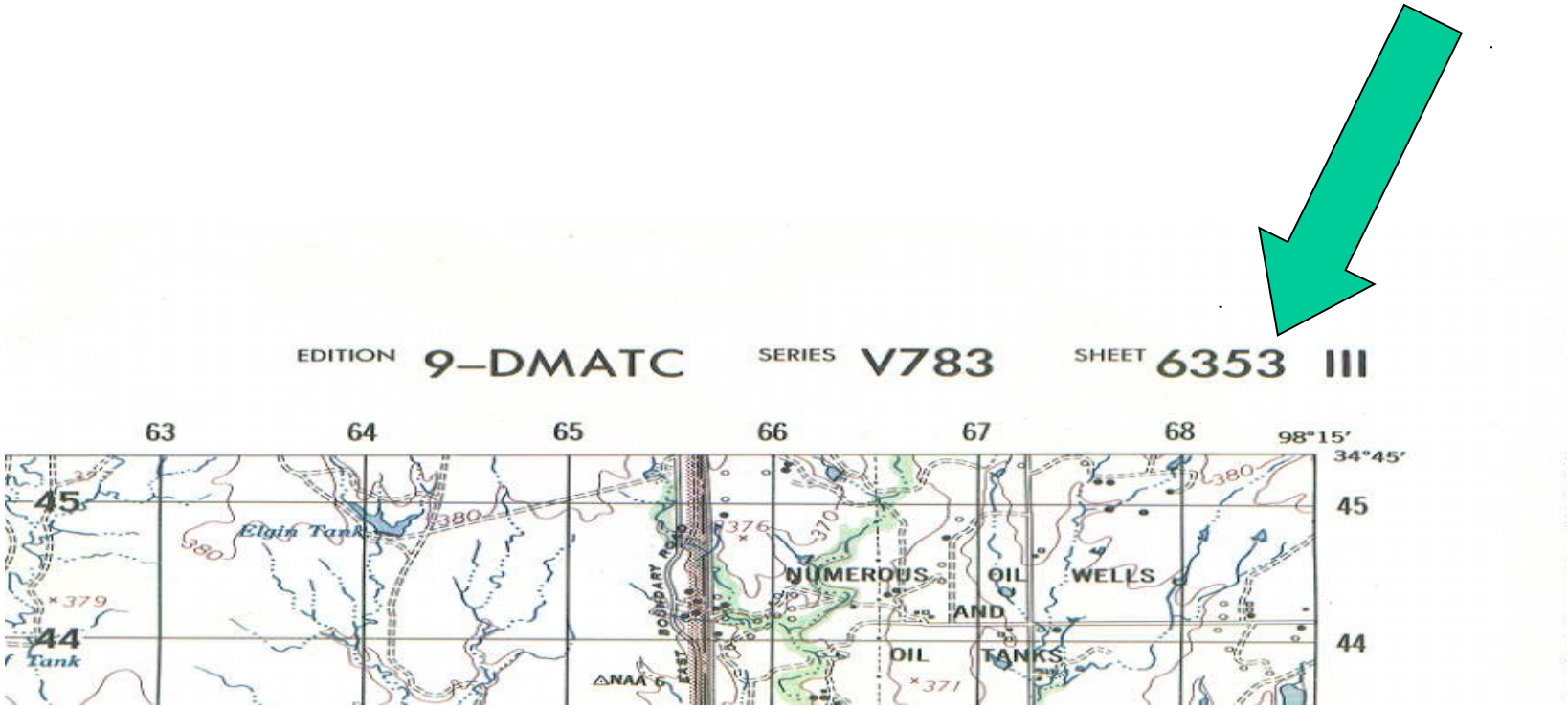
Series Number - It is a sequence reference expressed either as a four digit numeral (1125) or as a letter, followed by a three or fourdigit numeral (M661; T7110).

SSTC

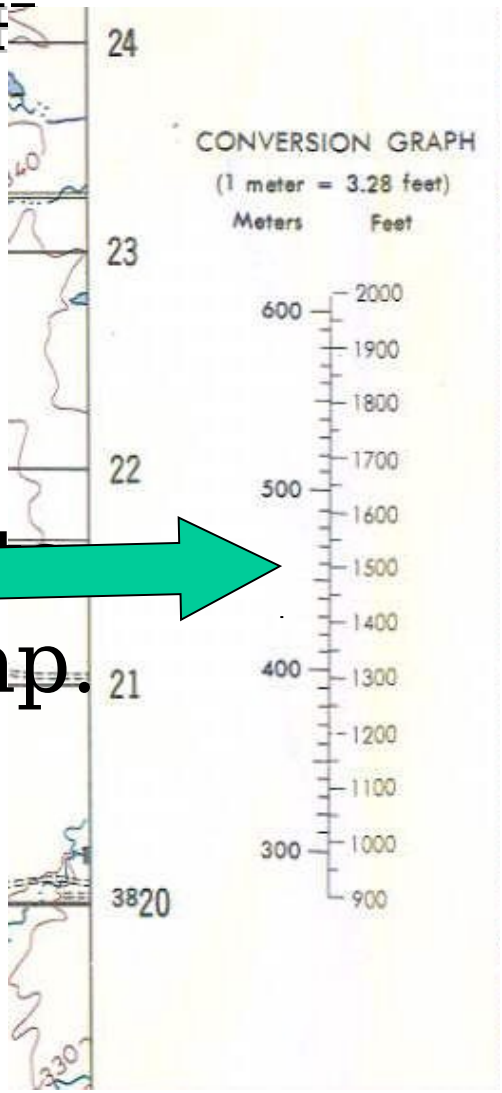
Sheet Number - It is used as a reference number to link specific r
to overlays, operations orders, and plans.



SSTC

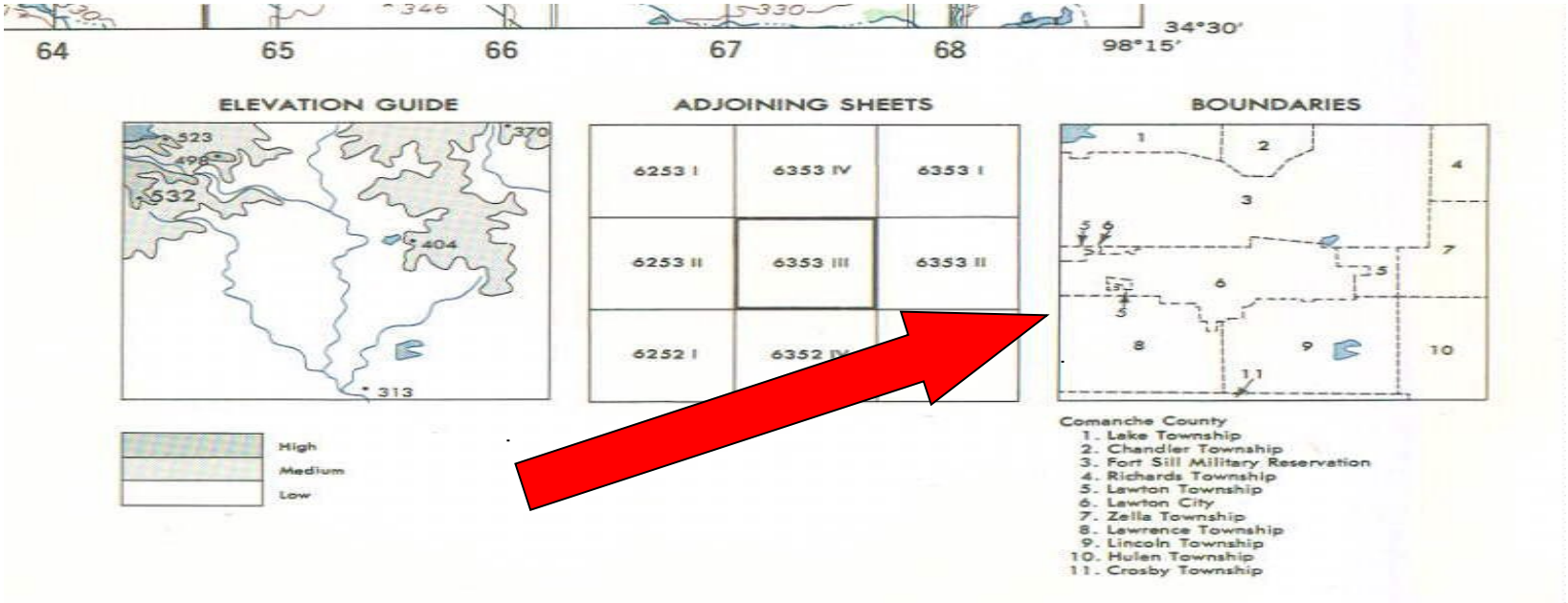
CONVERSION GRAPH

This graph indicates the conversion of different units of measure used on the map.



SSTC

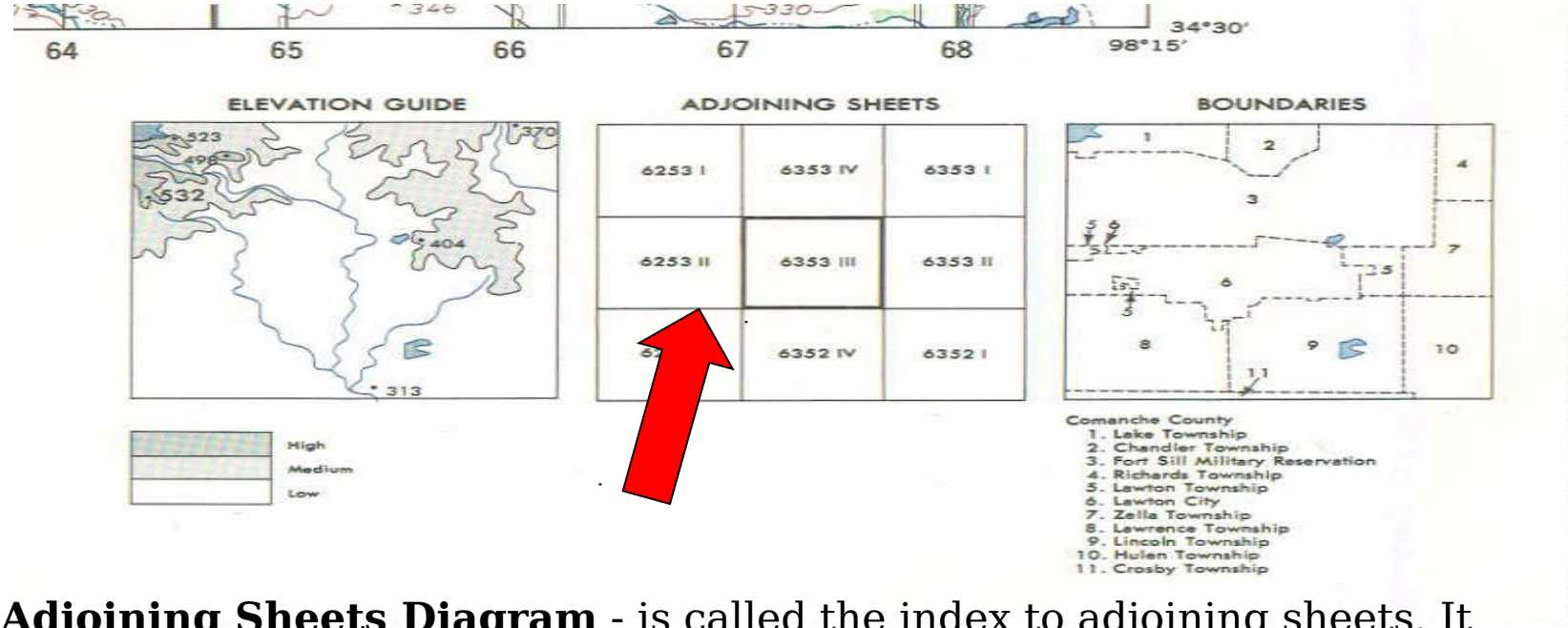
ELEVATION GUIDE, ADJOINING SHEETS, ET



Index to Boundaries - This diagram, which is a minia
the map, shows the boundaries that occur within the r
such as county lines and state boundaries.

SSTC

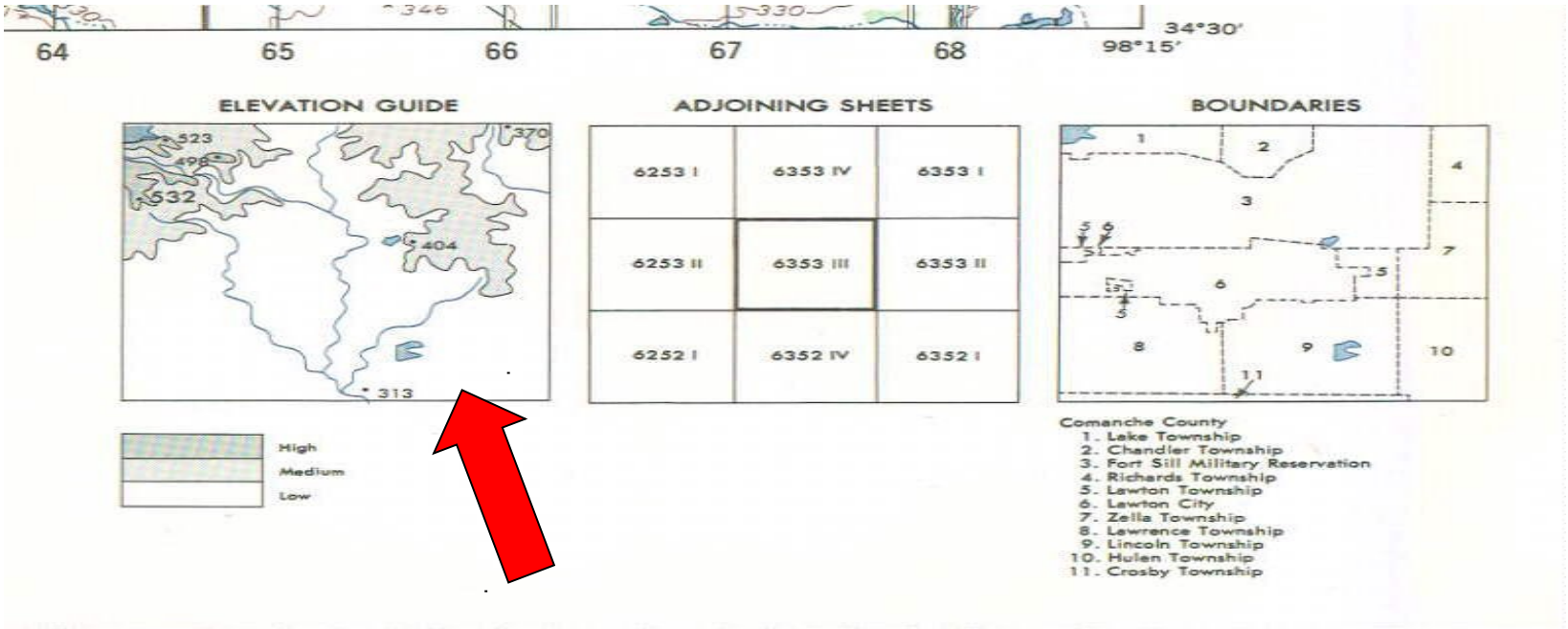
ELEVATION GUIDE, ADJOINING SHEETS, ET



Adjoining Sheets Diagram - is called the index to adjoining sheets. It consists of as many rectangles representing adjoining sheets as are necessary to surround the rectangle that represents the sheet under consideration. The diagram usually contains nine rectangles, but the number may vary depending on the locations of the adjoining sheets. All represented sheets are identified by their sheet numbers. Sheets of an adjoining series, whether published or planned, that are at the same scale are represented by dashed lines. The series number of the adjoining series is indicated along the appropriate side of the division line between the series.

SSTC

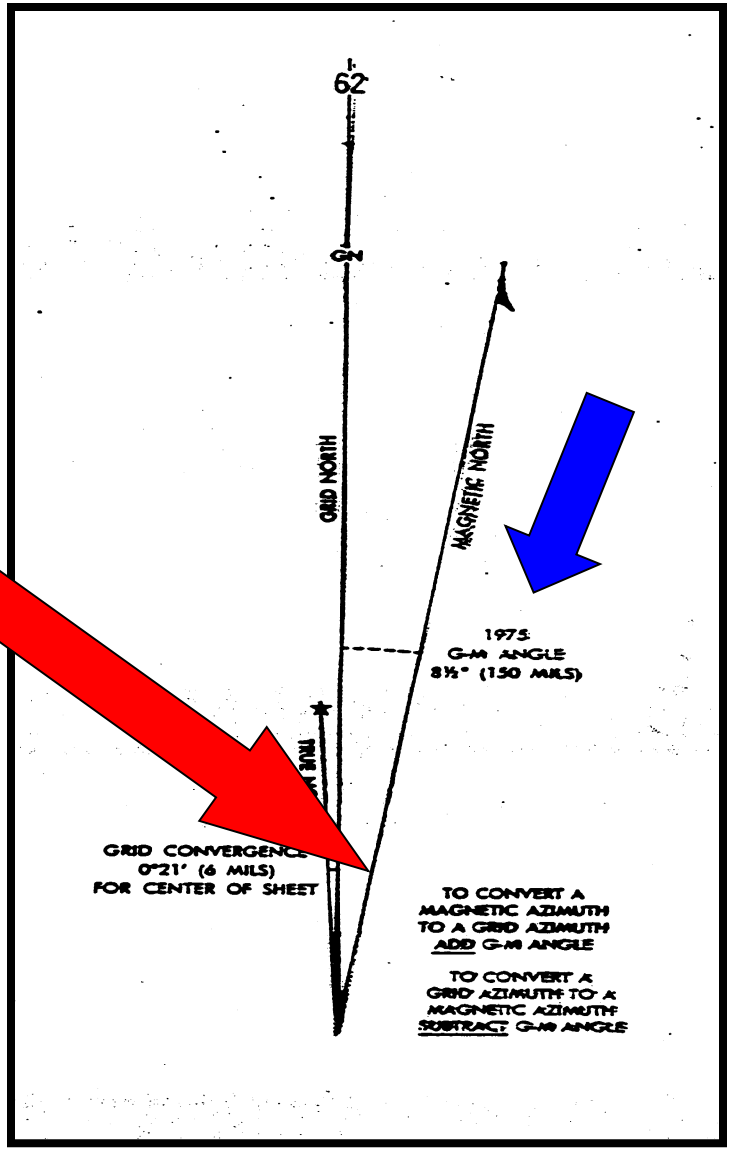
ELEVATION GUIDE, ADJOINING SHEETS, ET



Elevation Guide - The terrain is represented by bands of eleva spot elevations, and major drainage features. The elevation gui provides the map reader with a means of rapid recognition of major landforms.

SSTC

DECLINATION DIAGRAM

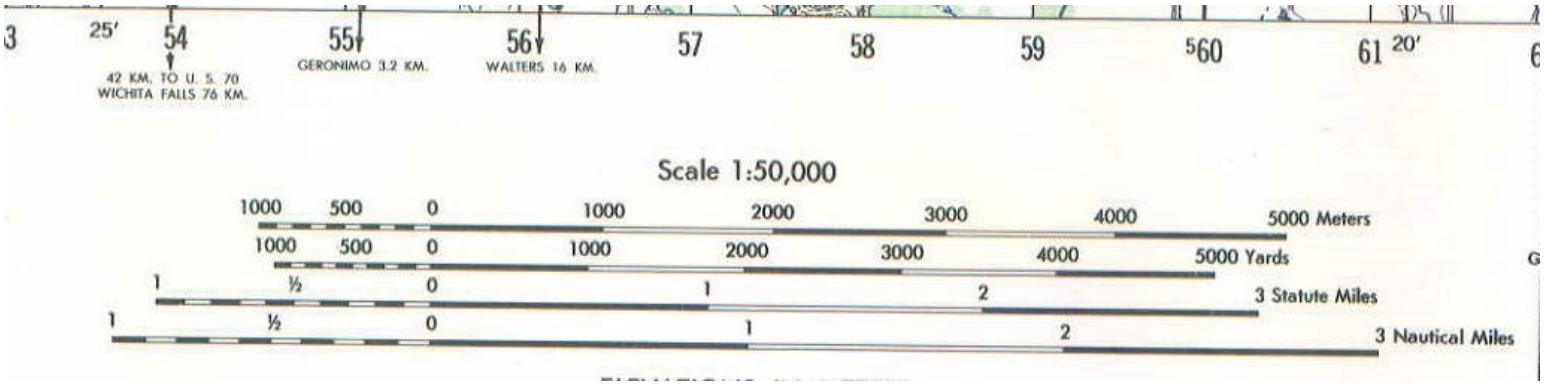


- IS THE ANGULAR DIFFERENCE BETWEEN ANY TWO NORTHS.
- IT IS LOCATED IN THE LOWER MARGIN ON MOST LARGER MAPS
- ON MEDIUM SCALE MAPS, THE DECLINATION INFO IS SHOWN BY A NOTE IN TH MAP MARGIN

SSTC

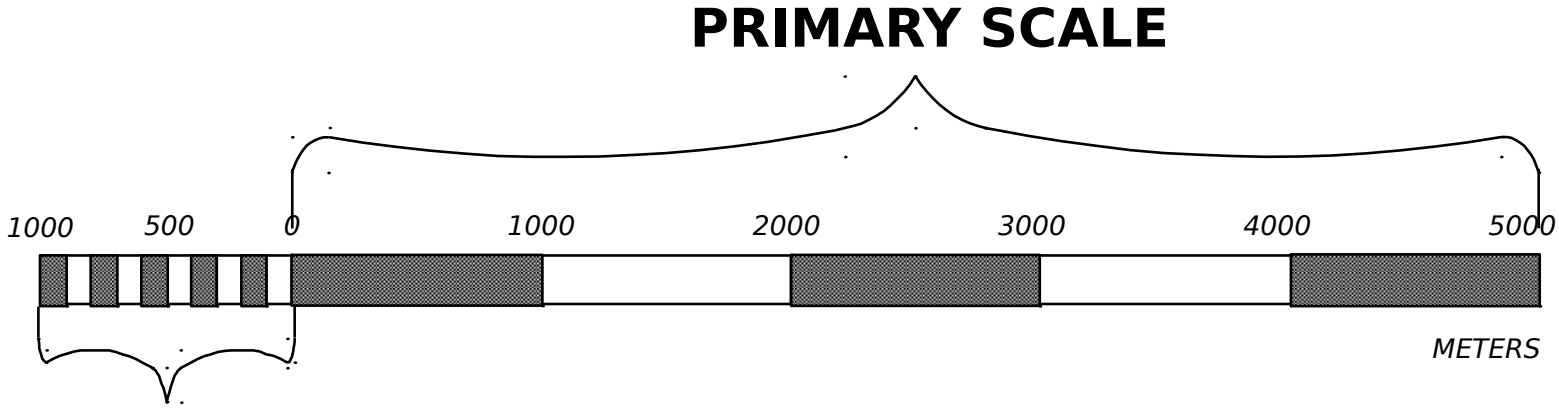
BAR SCALES

A GRAPHIC BAR SCALE IS A RULER PRINTED ON THE MAP AND USED TO CONVERT DISTANCES ON THE MAP TO ACTUA GROUND DISTANCE.



SSTC

PRIMARY / EXTENSION SCALE



SSTC

CONTOUR INTERVAL NOTE

Contour Interval Note - This note is found in the center of th
margin normally below the bar scales. It states the vertical dis
between adjacent contour lines of the map. When supplementa
contours are used, the interval is indicated. In recent edition m
the contour interval is given in meters instead of feet.

SSTC

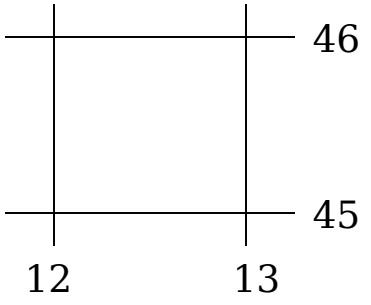
ELEVATION IN METERS

CONTOUR INTERVAL 10 METERS

SUPPLEMENTARY CONTOURS 5 METERS

SPIEROID.....CLARKE 1866
GRID..... ..... 1,000 METER, UTM ZONE 14
PROJECTION.....TRANSVERSE MERCATOR
VERTICAL DATUM.....NATIONAL GEODETIC, VERTICAL DATUM OF 1929
HORIZONTAL DATUM.....1927 NORTH AMERICAN DATUM
CONTROL BY.....NOS/NOAA, USGS, CE AND OKLAHOMA GEODETIC SURVEY
PRINTED BY.....DEFENSE MAPPING AGENCY TOPOGRAPHIC CENTER 9-97
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225
OR RESTON, VIRGINIA 22092

SAMPLE 1,000 METER GRID SQUARE



100,000 M SQUARE IDENTIFICATION

NP

GRID ZONE DESIGNATION

14S

100 METER REFERENCE

1. Read large numbers labeling the VERTICAL grid line left of point and estimate tenths (100 meters) from grid line to point 12 3

2. Read large numbers labeling the HORIZONTAL grid line below point and estimate tenths (100 meters) from grid line to point. 45 6

Example: 123456

WHEN REPORTING ACROSS A 100,000 METER LINE, PREFIX THE 100,000 METER SQUARE INDENTIFICATION, IN WHICH THE POINT LIES

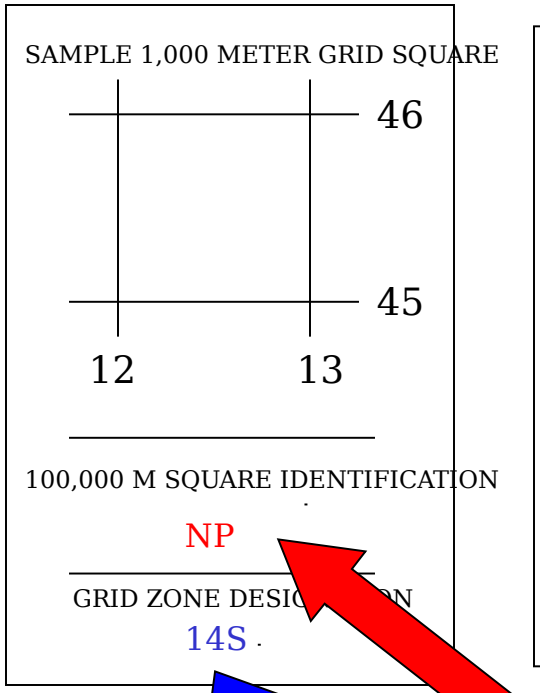
EXAMPLE: NP 123456

WHEN REPORT OUTSIDE THE GRID ZONE DESIGNATION AREA, PREFIX THE GRID ZONE DESIGNATION

EXAMPLE: 14SNP123456

SSTC

Grid Reference Box - It contains instructions for composing a grid reference.



100 METER REFERENCE

1. Read large numbers labeling the VERTICAL grid line left of point and estimate tenths (100 meters) from grid line to point 12 3

2. Read large numbers labeling the HORIZONTAL grid line below point and estimate tenths (100 meters) from grid line to point. 45 6

Example: 123456

WHEN REPORTING ACROSS A 100,000 METER LINE, PREFIX THE 100,000 METER SQUARE INDENTIFICATION, IN WHICH THE POINT LIES

EXAMPLE: NP 123456

WHEN REPORT OUTSIDE THE GRID ZONE DESIGNATION AREA, PREFIX THE GRID ZONE DESIGNATION

EXAMPLE: 14SNP123456

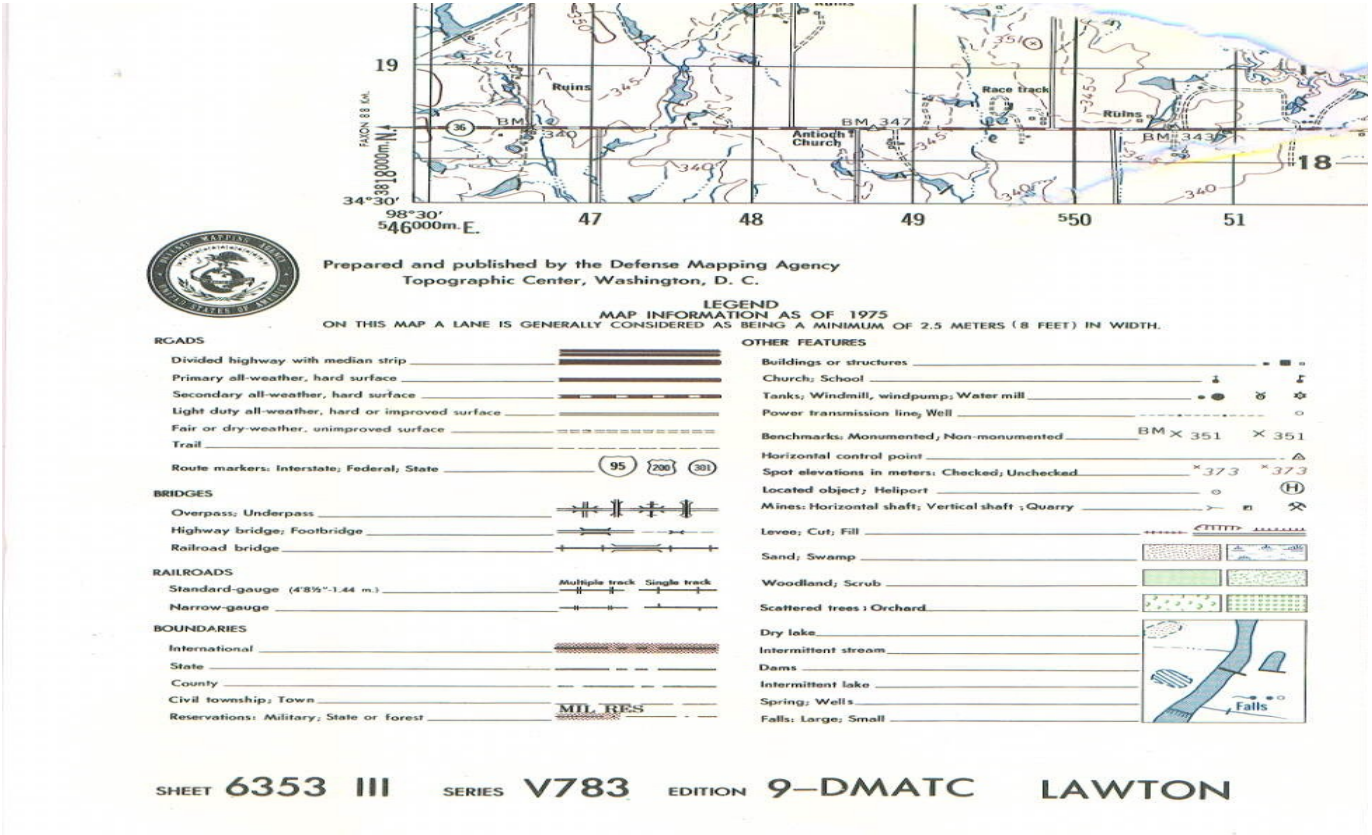
100,000 M SQUARE IDENTIFICATION

GRID ZONE DESIGNATION

SSTC

THE LEGEND OF THE MAP

Legend - It illustrates and identifies the topographic symbols depict some of the more prominent features on the map. The sy are not always the same on every map. Always refer to the lege avoid errors when reading a map.



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COLORS OF THE MAP

BLACK: MAN-MADE FEATURES, SUCH AS BUILDINGS AND ROADS.

REDDISH-BROWN: RELIEF FEATURES AND ELEVATION (CONTOUR LINES ON RED-LIGHT READABLE MAPS).

BLUE: HYDROGRAPHY (WATER).

GREEN: VEGETATION (WOODS, ORCHARDS).

BROWN: RELIEF & ELEVATION (CONTOUR LINES ON OLDER EDITION MAPS).

RED: POPULATED AREAS, MAIN ROADS AND BOUNDARIES ON OLDER MAPS.

OTHER: OCCASIONALLY OTHER COLORS MAY BE USED TO SHOW SPECIAL INFORMATION. THESE ARE INDICATED IN THE MARGINAL INFORMATION AS A RULE.

SSTC

HILL: AN AREA OF HIGH GROUND. FROM A HILLTOP, THE GROUND SLOPE DOWN IN ALL DIRECTIONS.

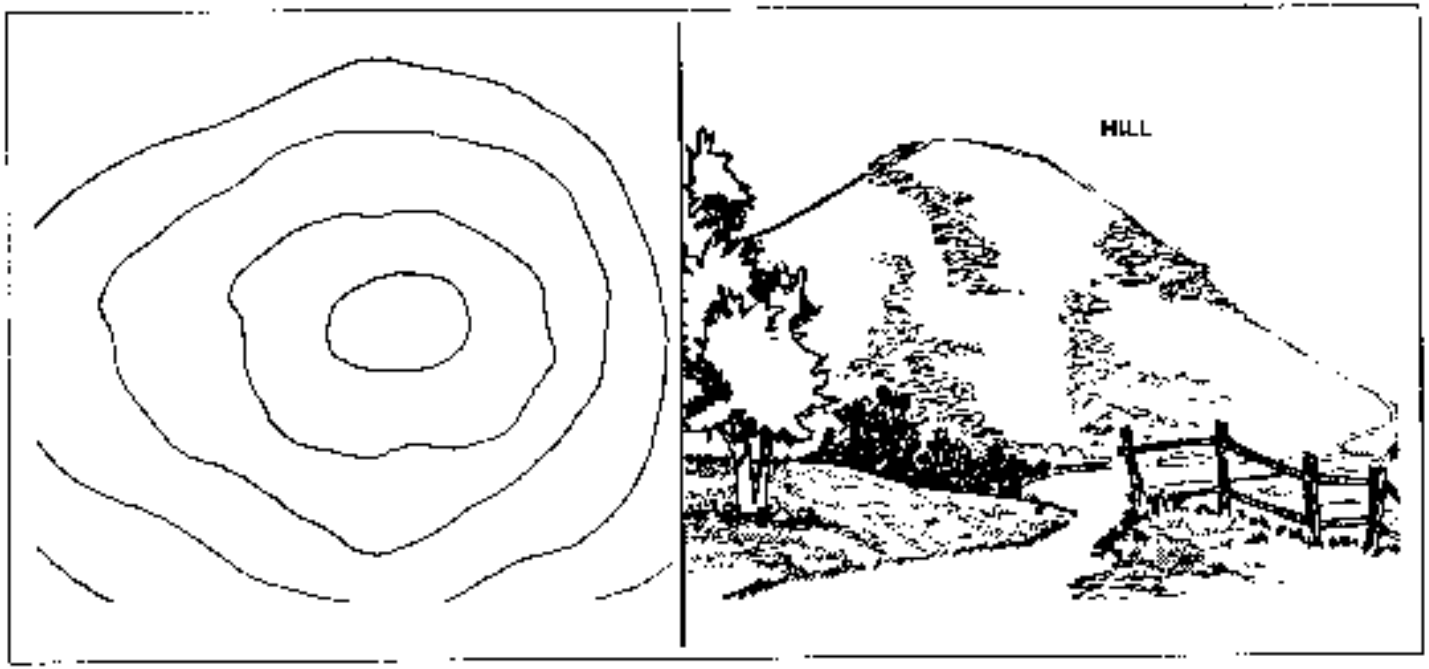
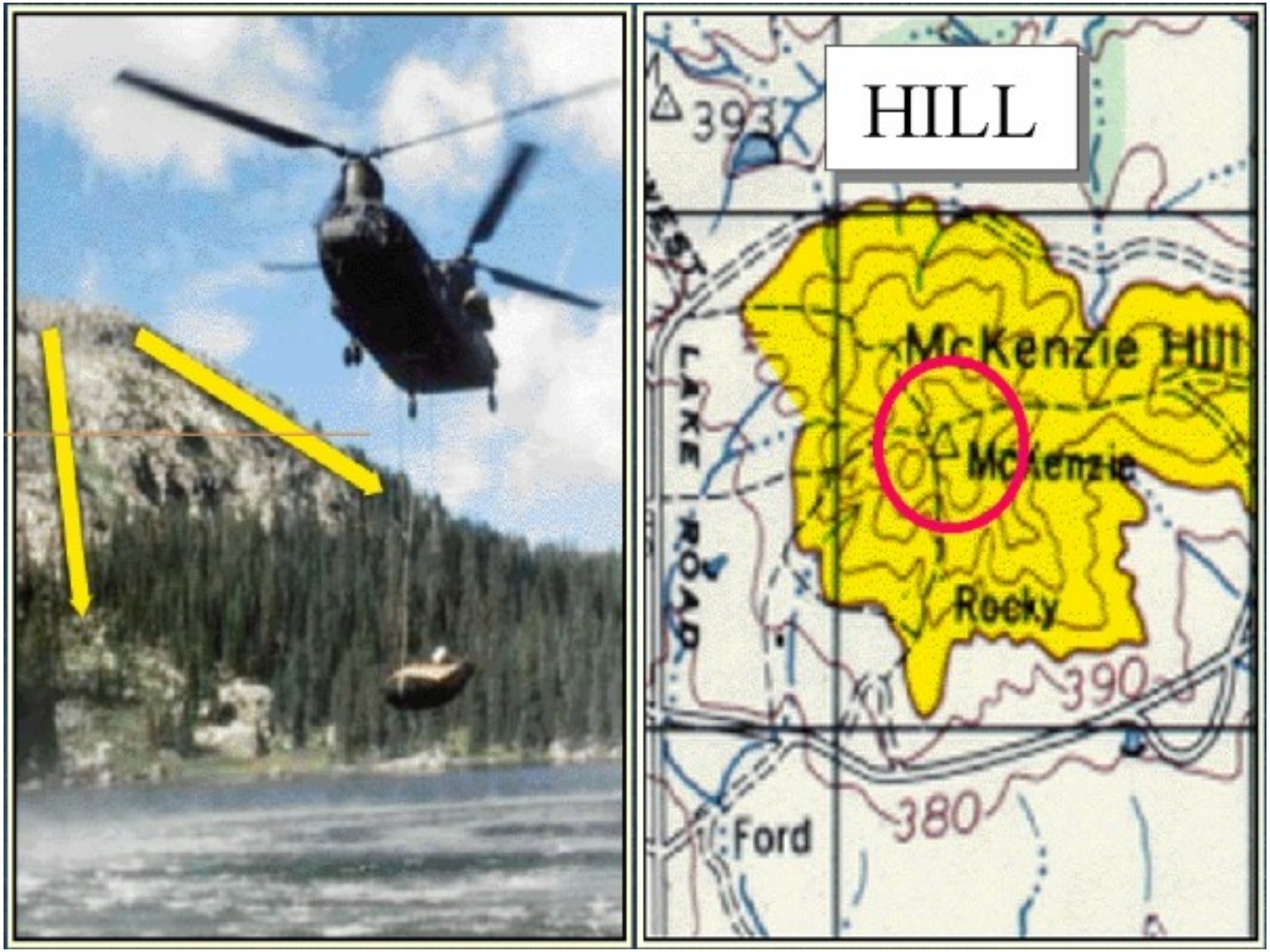


Figure 10-17. Hill.

SSTC


HILL
393
McKenzie Hill
McKenzie
Rocky
LAKE ROAD
390
380
Ford

SSTC

RIDGE: A SLOPING LINE OF HIGH GROUND.

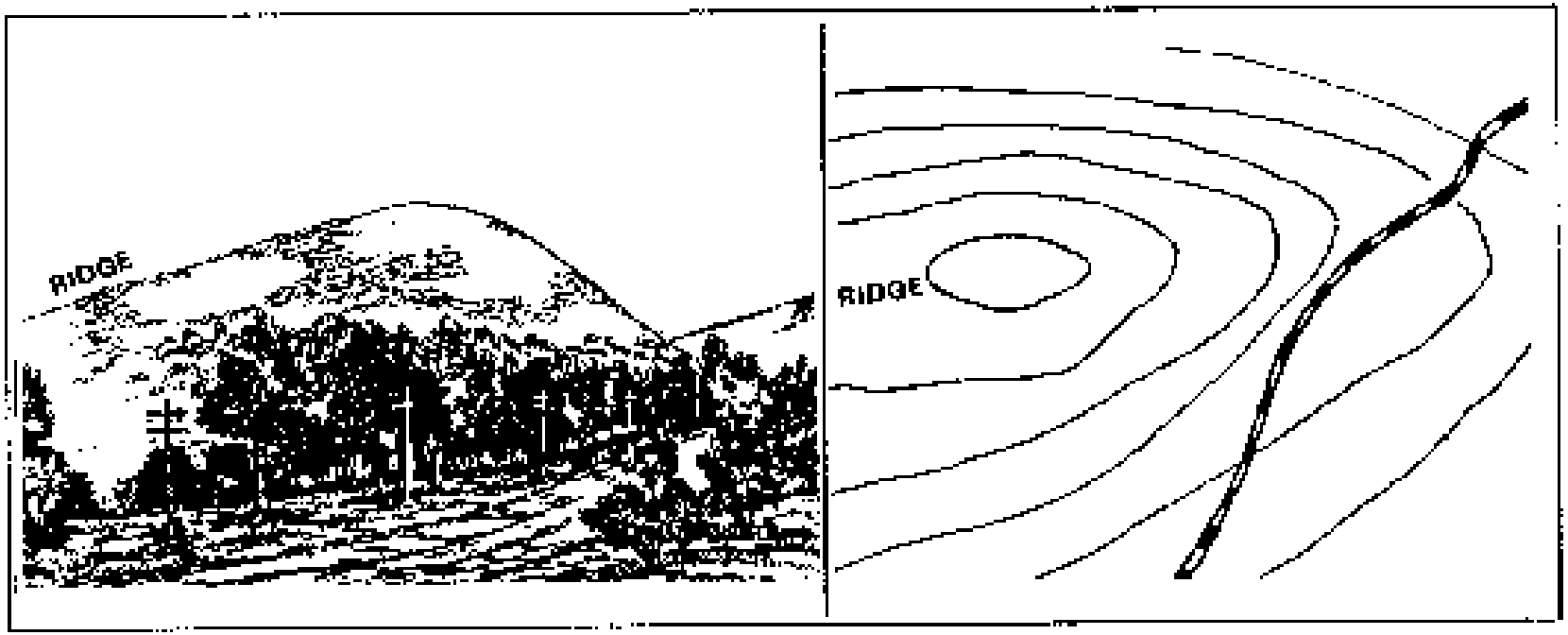
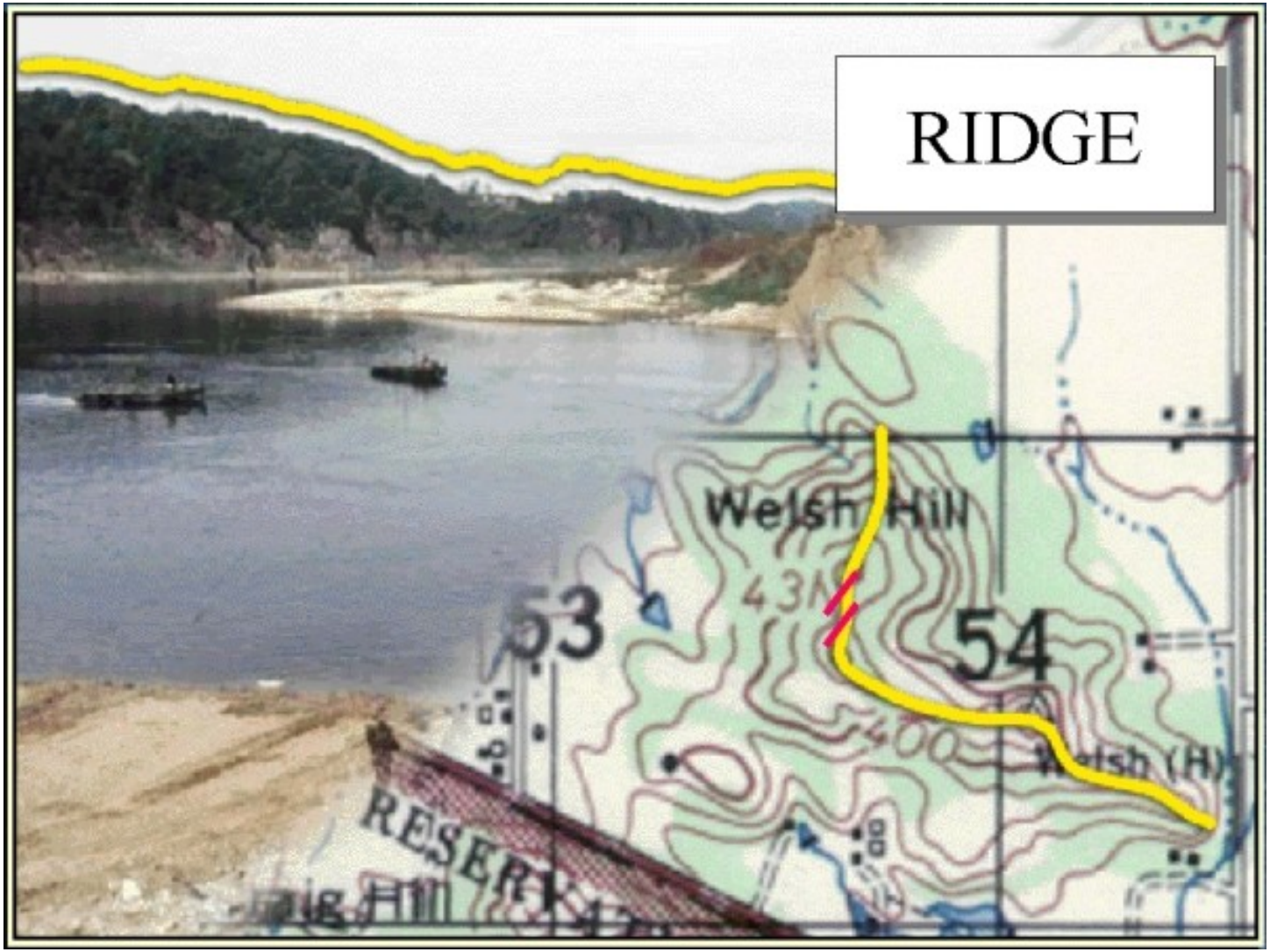


Figure 10-20. Ridge.

SSTC



SSTC

VALLEY: A STRETCHED-OUT GROOVE IN THE LAND, USUALLY FORMED BY STREAMS OR RIVERS.

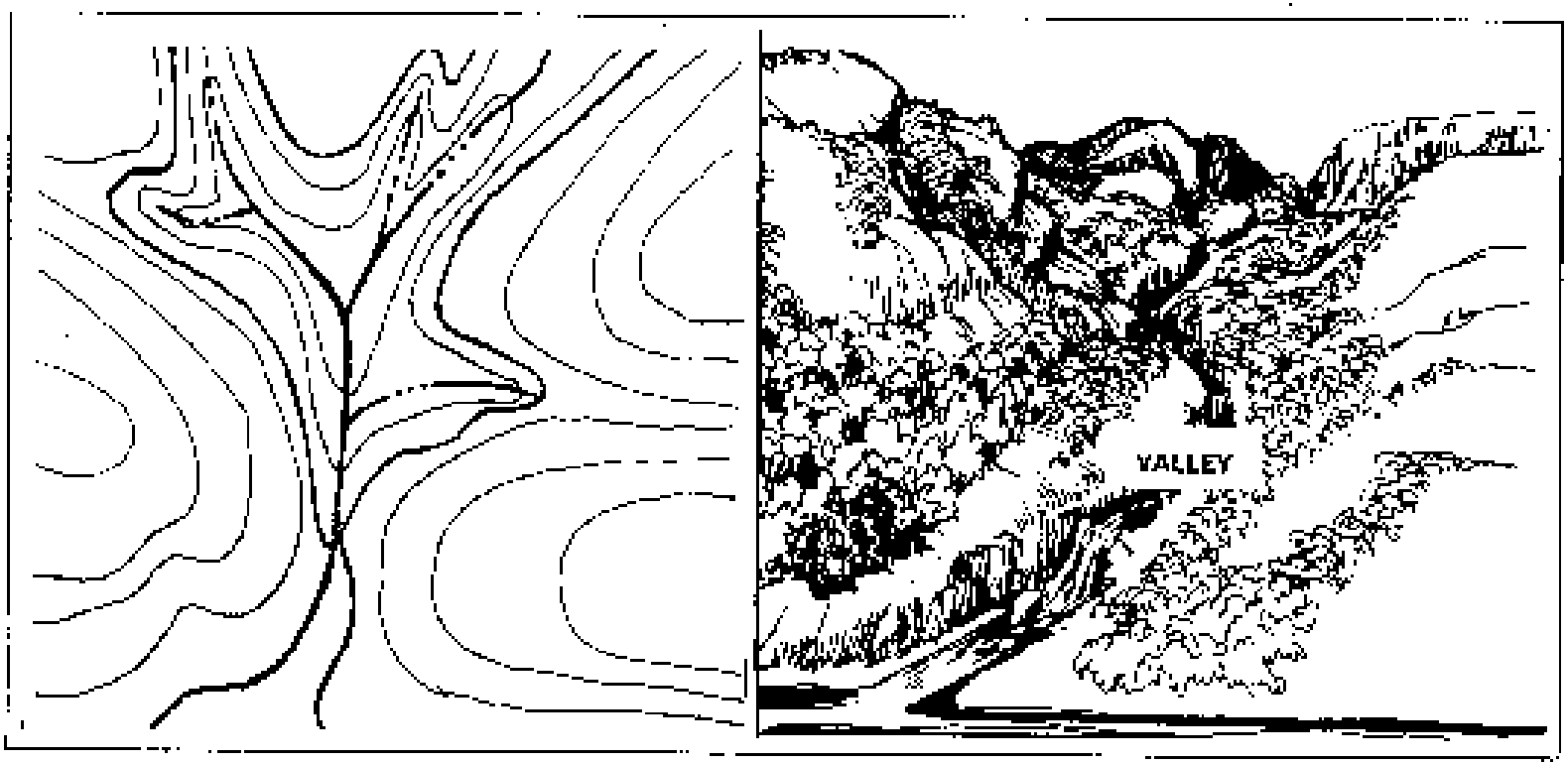
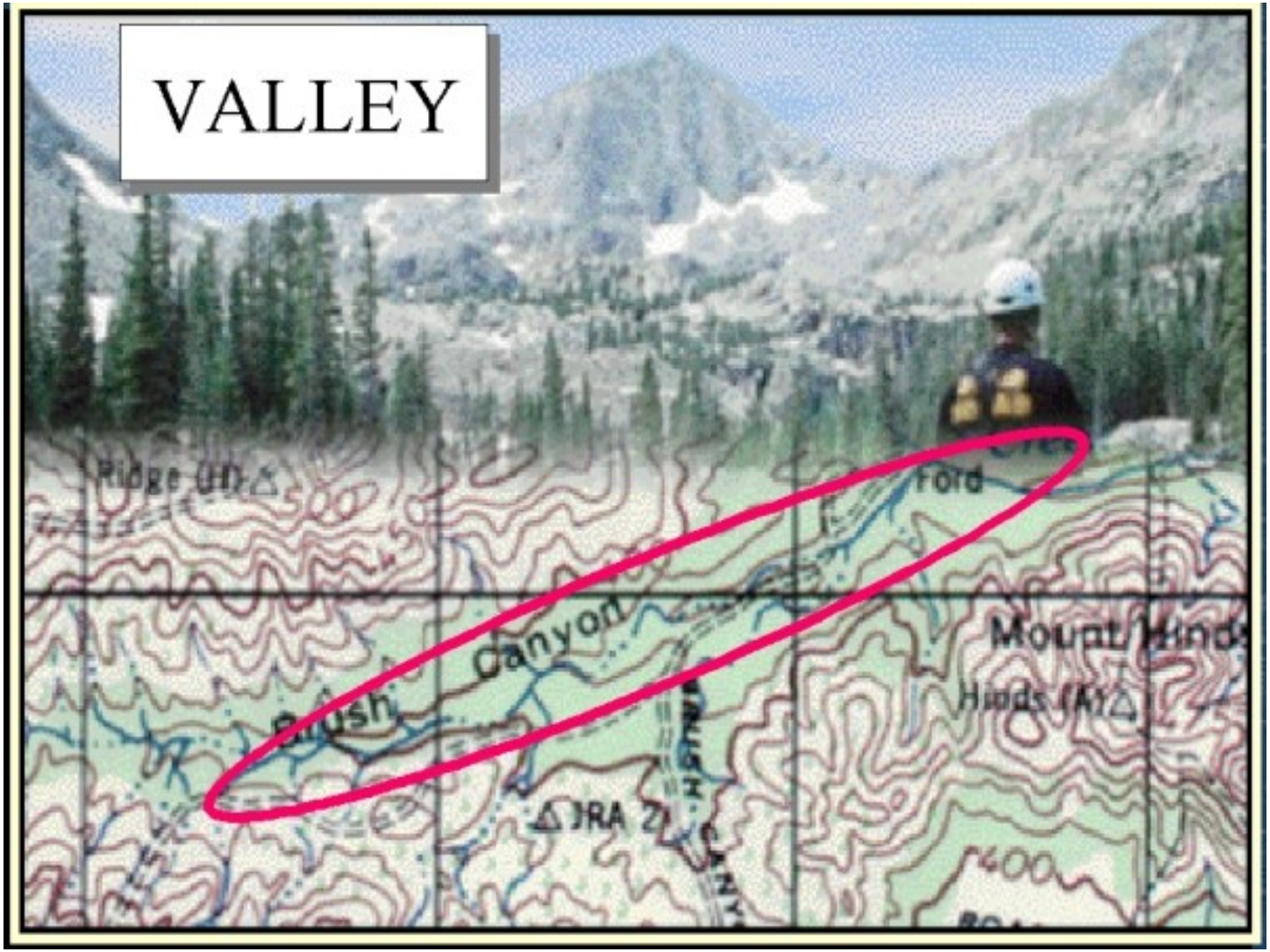


Figure 10-19. Valley.



SSTC

SADDLE: A DIP OR LOW POINT BETWEEN TWO AREAS OF HIGHER GROUND.

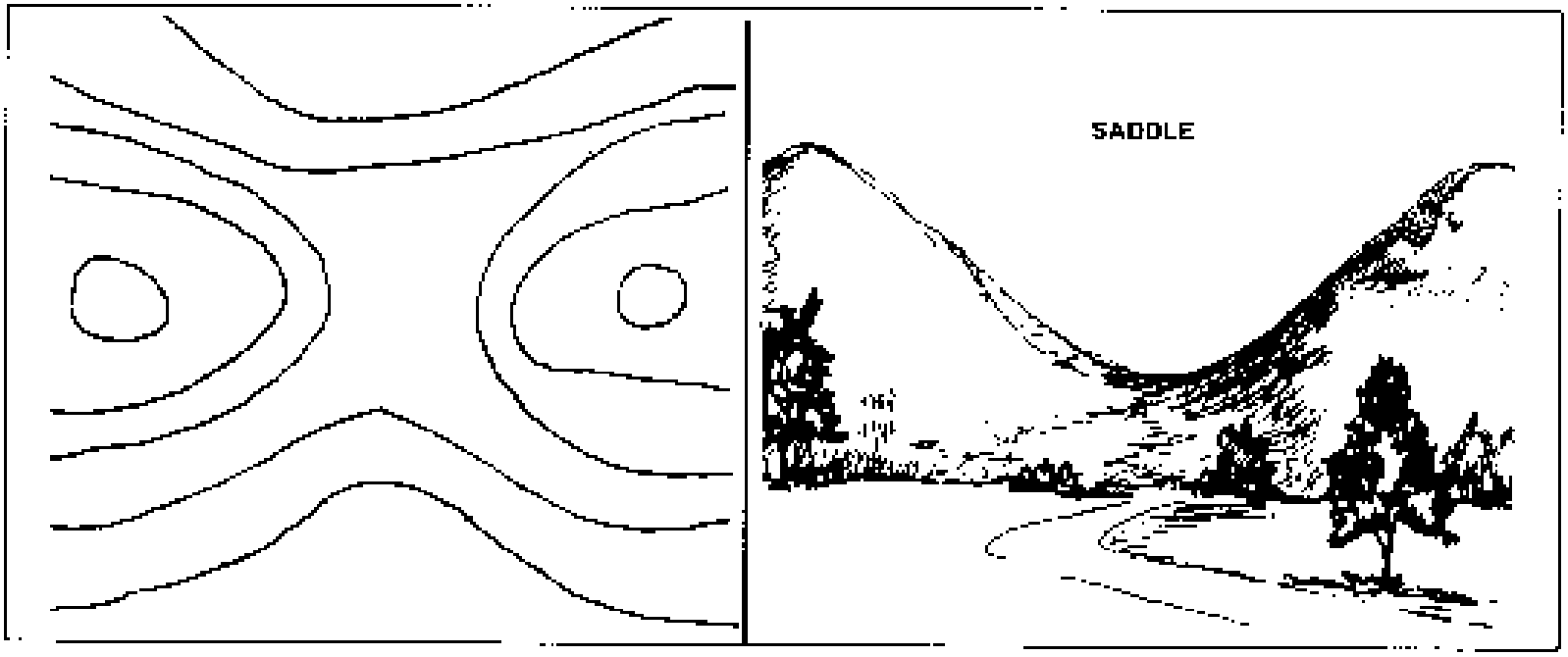
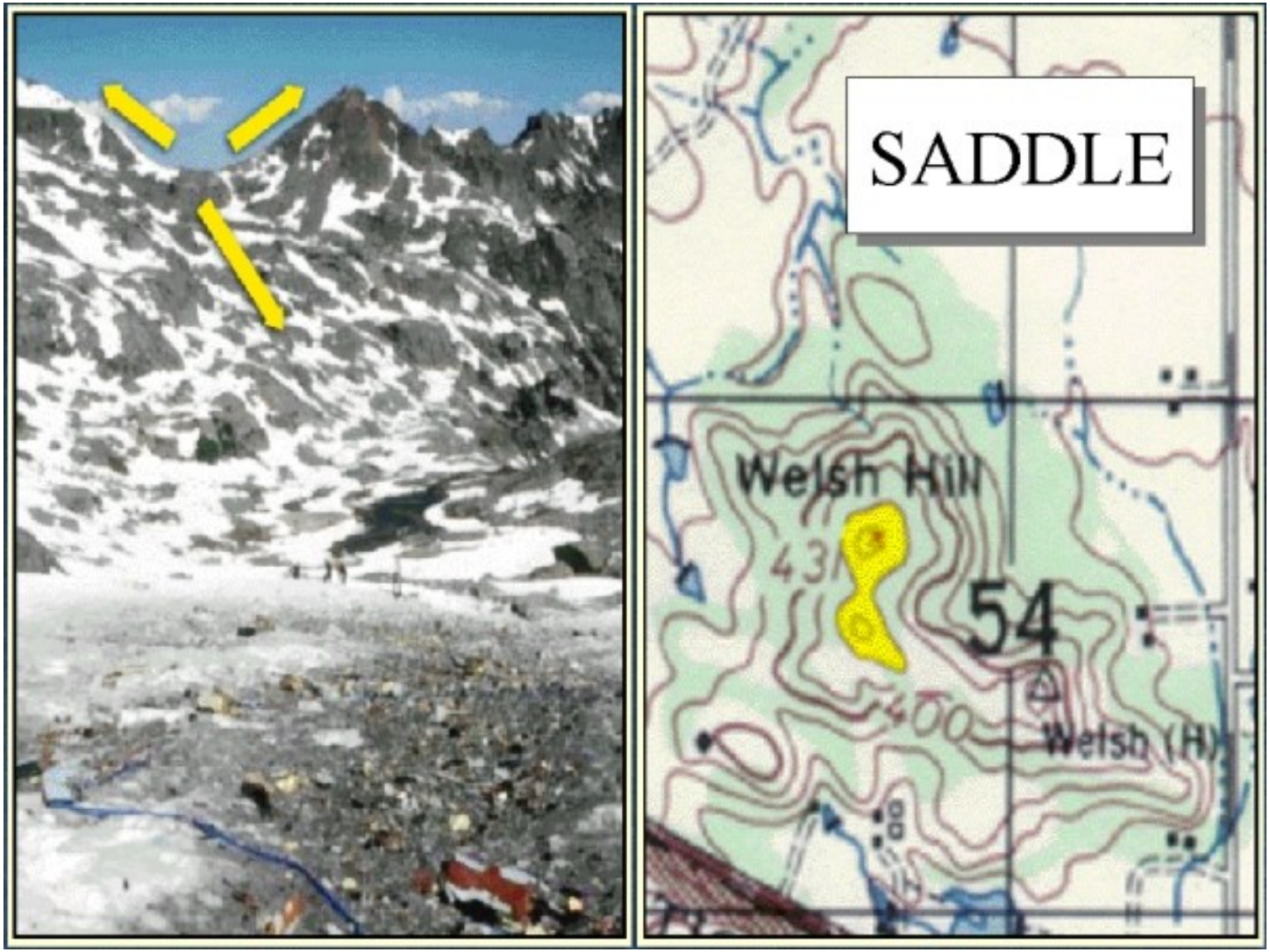


Figure 10-18. Saddle.

SSTC



SSTC

DEPRESSION: A LOW POINT IN THE GROUND OR SINKHOLE. THEY ARE REPRESENTED BY CLOSE CONTOUR LINES THAT HAVE TICK MARKS POINTING TOWARD LOW GROUND.

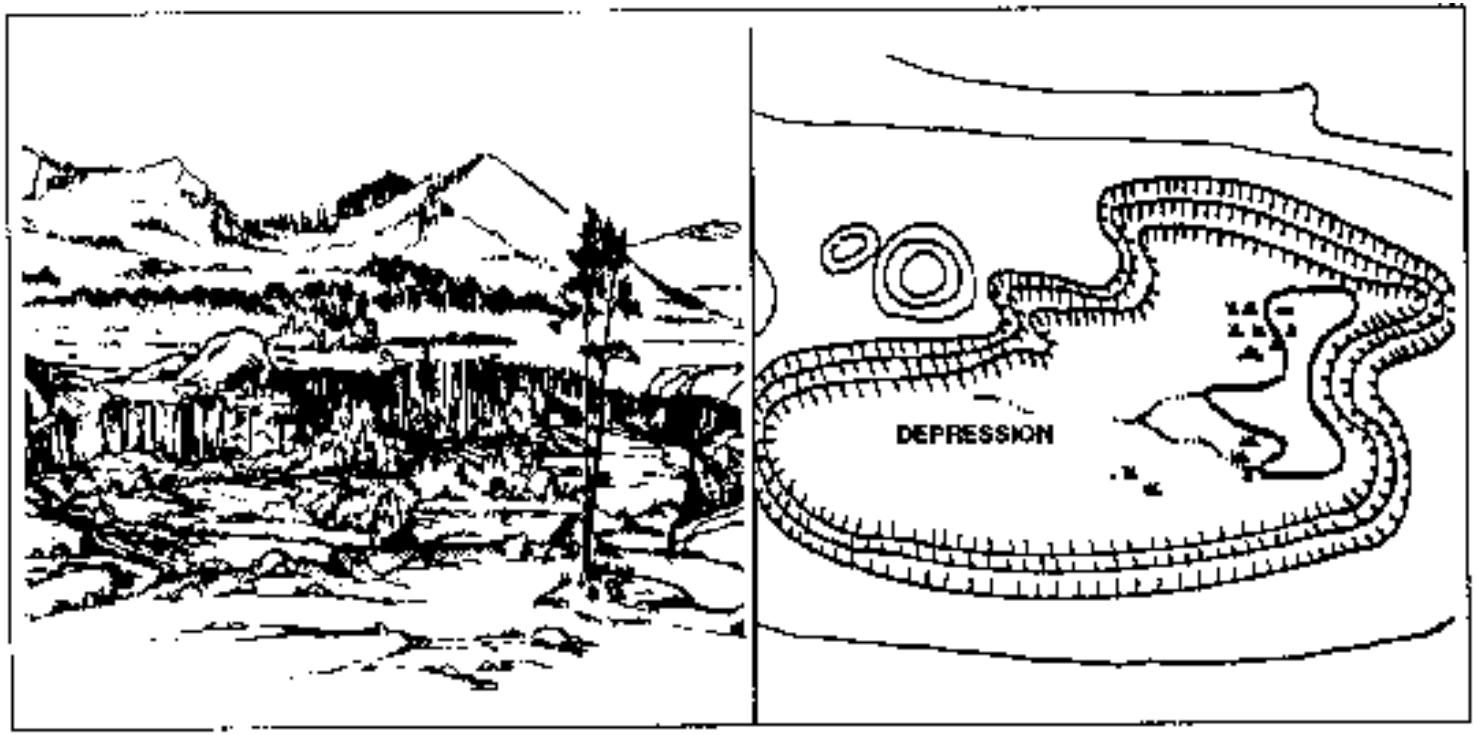


Figure 10-21. Depression.

SSTC

DRAW: A LESS DEVELOPED STREAM COURSE THAN A VALL
THERE IS ESSENTIALLY NO LEVEL GROUND AND, THEREFO
LITTLE OR NO MANEUVER ROOM WITHIN ITS CONFINES.

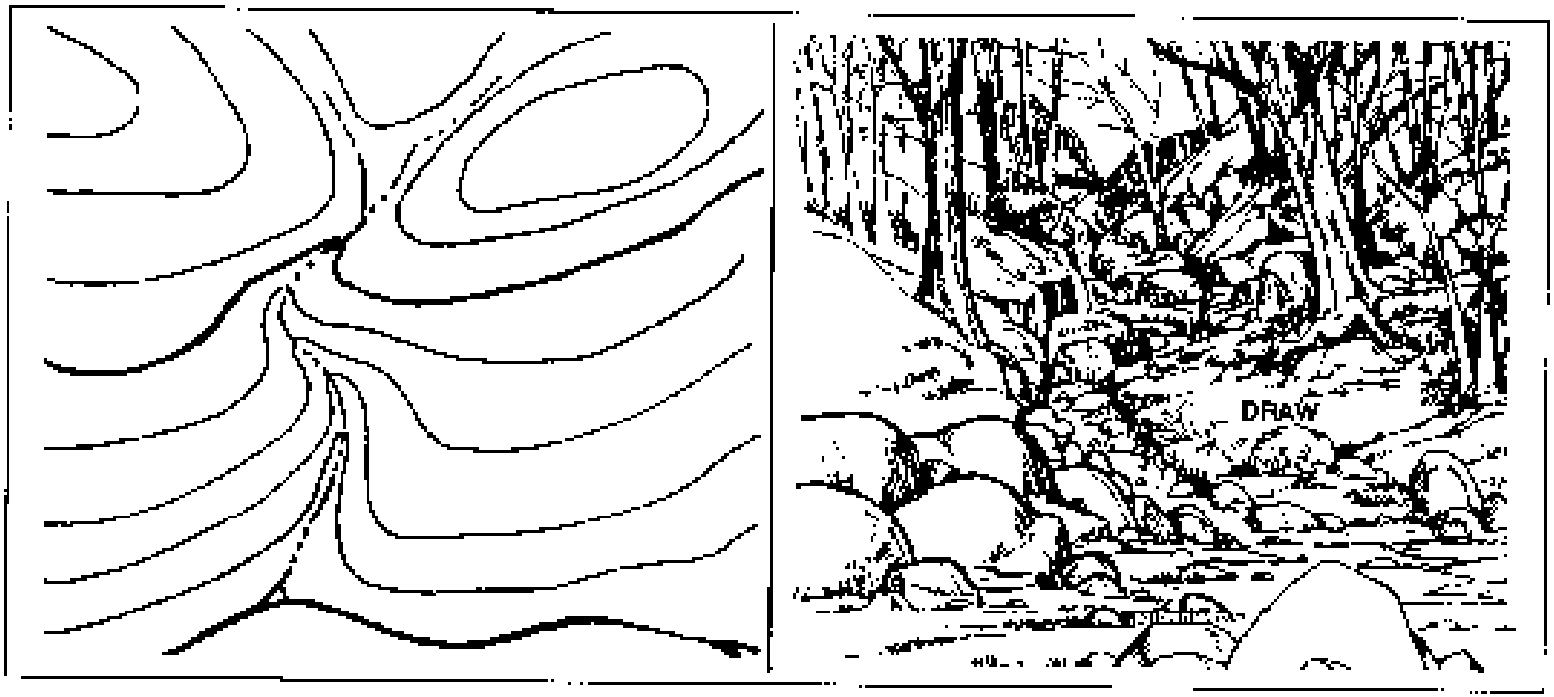
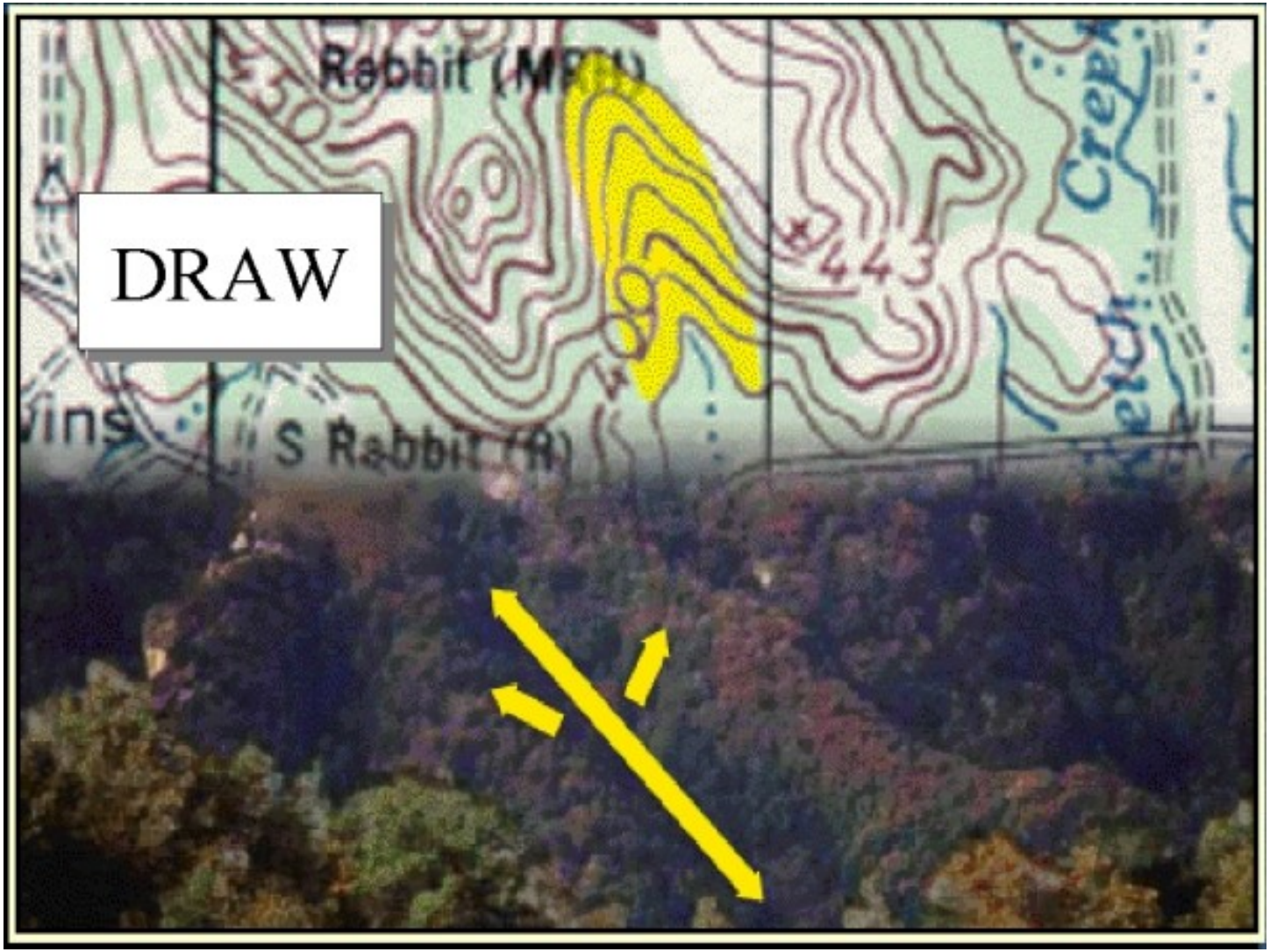


Figure 10-22. Draw.

SSTC



SSTC

SPUR: A SHORT, CONTINUOUS SLOPING LINE OF HIGHER GROUND, NORMALLY JUTTING OUR FROM THE SIDE OF A RIDGE.

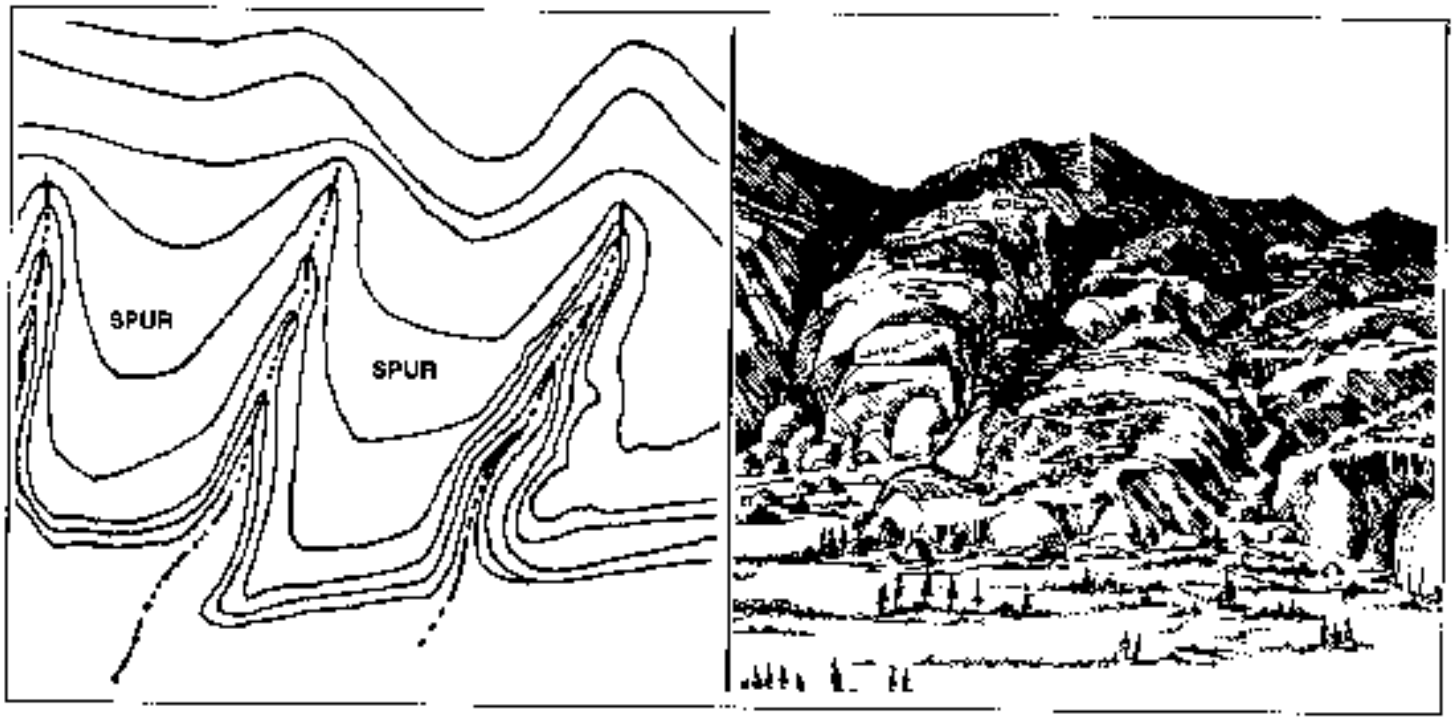
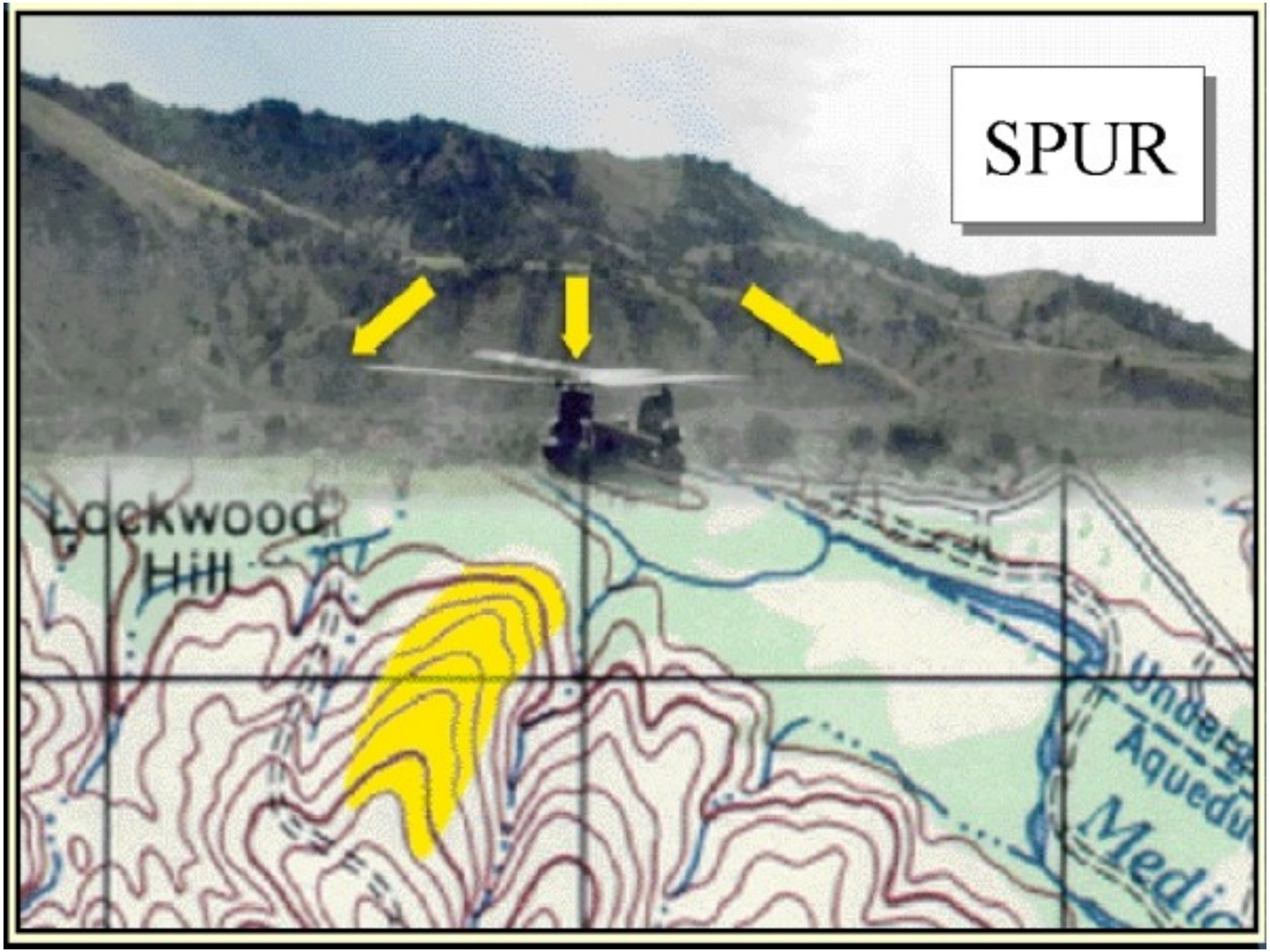


Figure 10-23. Spur.

SSTC



SSTC

CLIFF: A VERTICAL OR NEAR VERTICAL FEATURE; IT IS AN ABRUPT CHANGE OF THE LAND. THE SLOPE IS SO STEEP THAT THE CONTOUR LINES CONVERGE INTO ONE CONTOUR LINE OR THE LA CONTOUR LINE HAS TICK MARKS POINTING TO LOW GROUND.

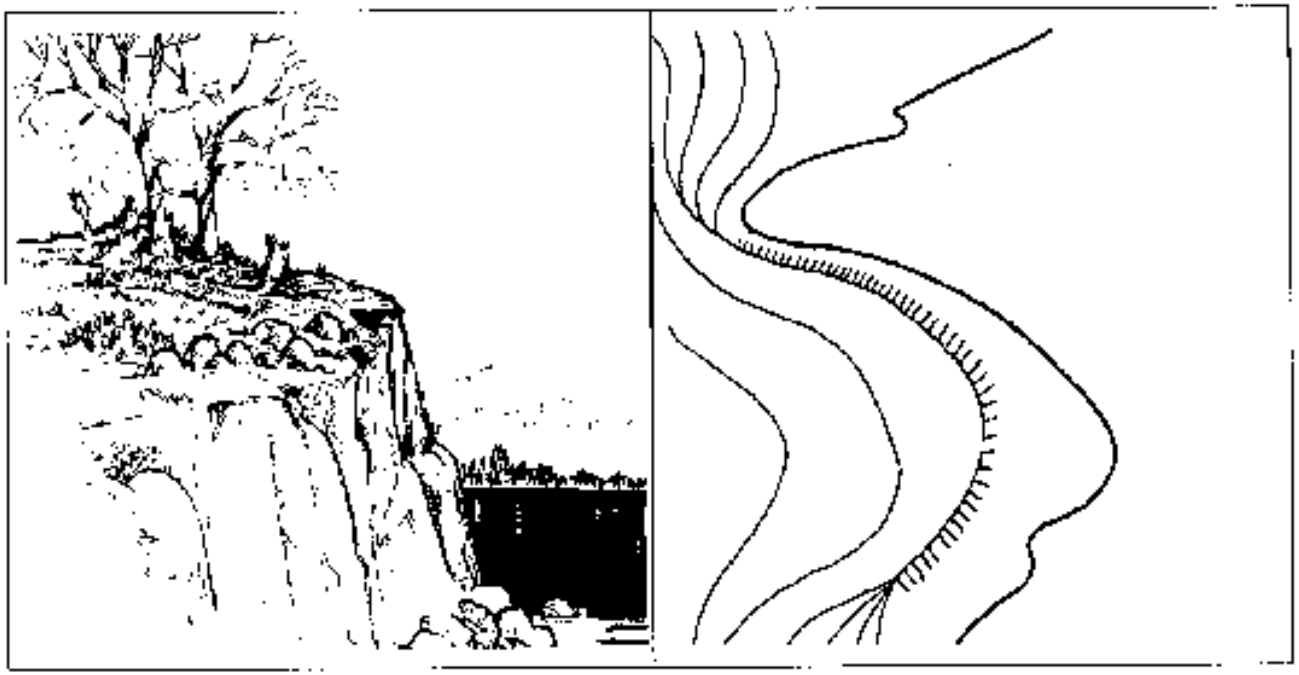


Figure 10-24A. Cliff.

SSTC

CLIFF: A VERTICAL OR NEAR VERTICAL FEATURE; IT IS AN ABRUPT CHANGE OF THE LAND. THE SLOPE IS SO STEEP THAT THE CONTOUR LINES CONVERGE INTO ONE CONTOUR LINE OR THE LA CONTOUR LINE HAS TICK MARKS POINTING TO LOW GROUND.

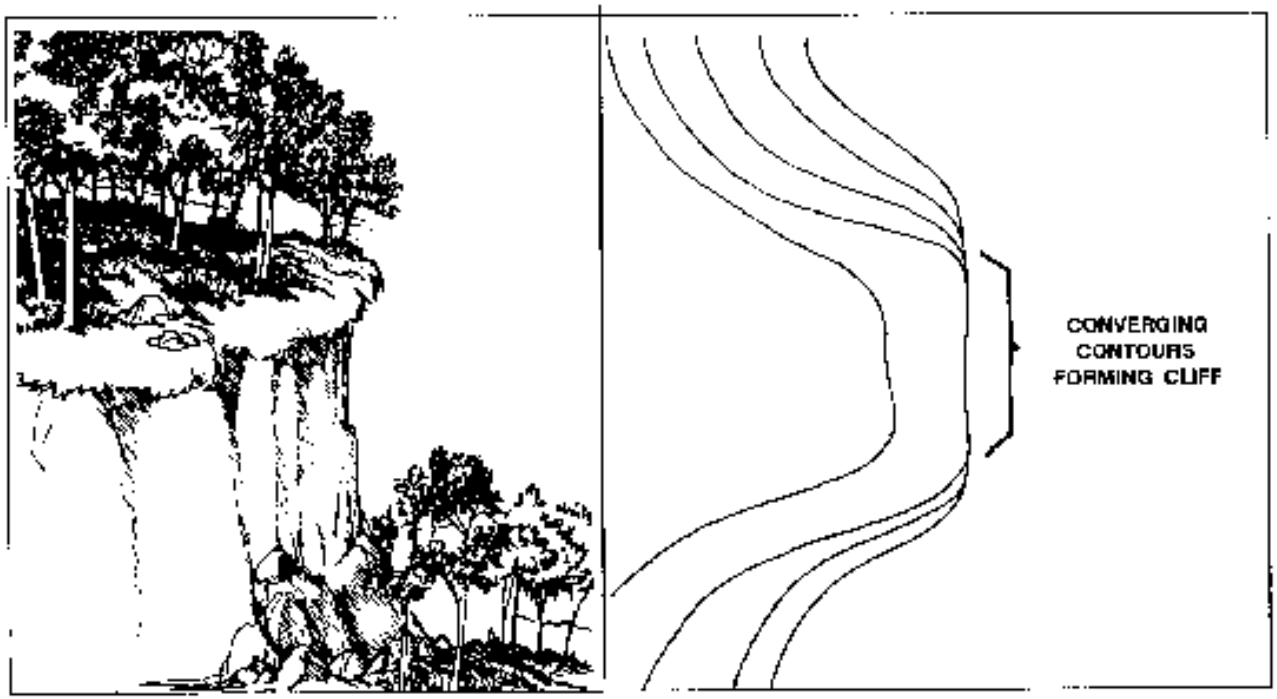
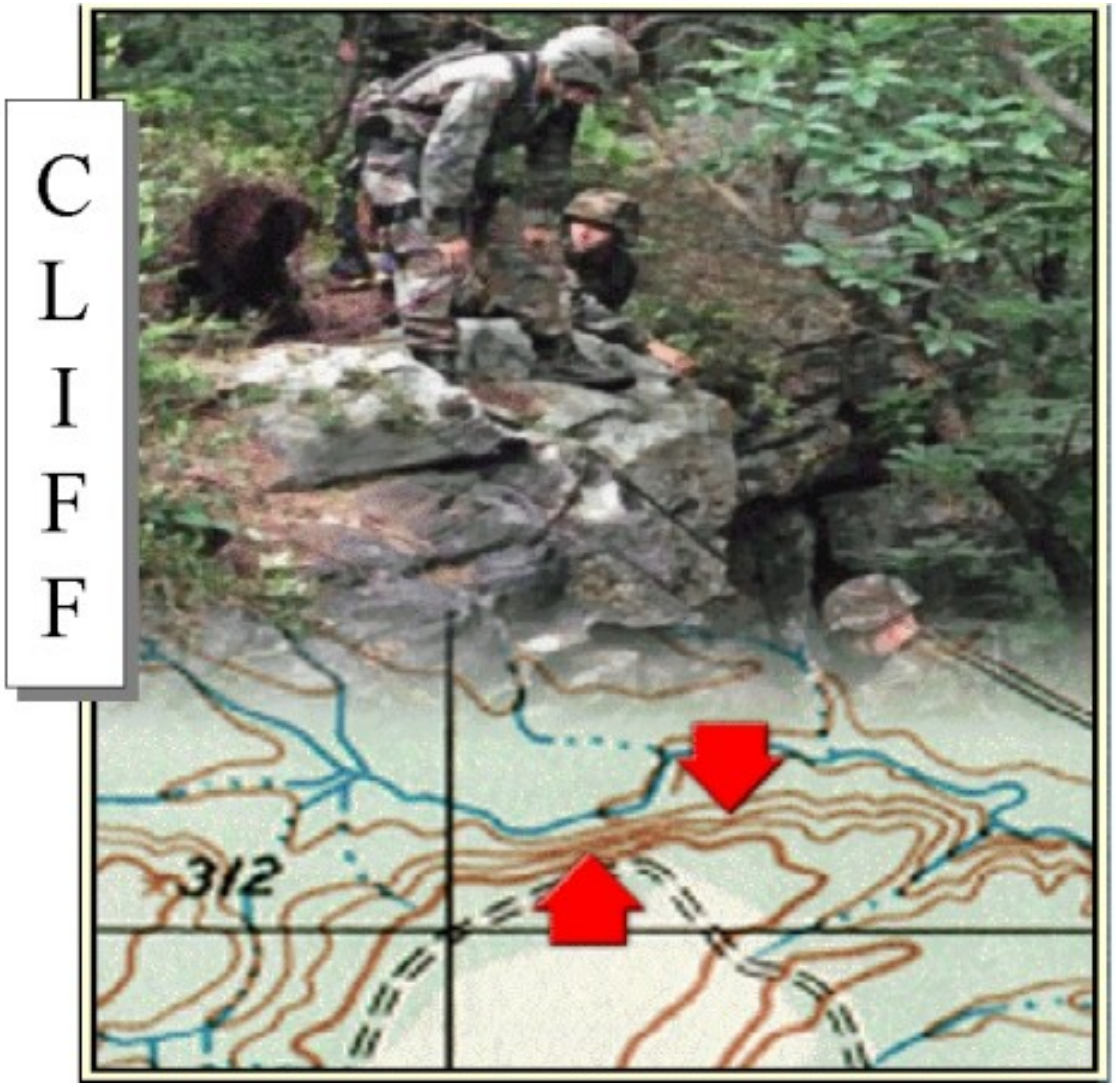


Figure 10-24B. Cliff.

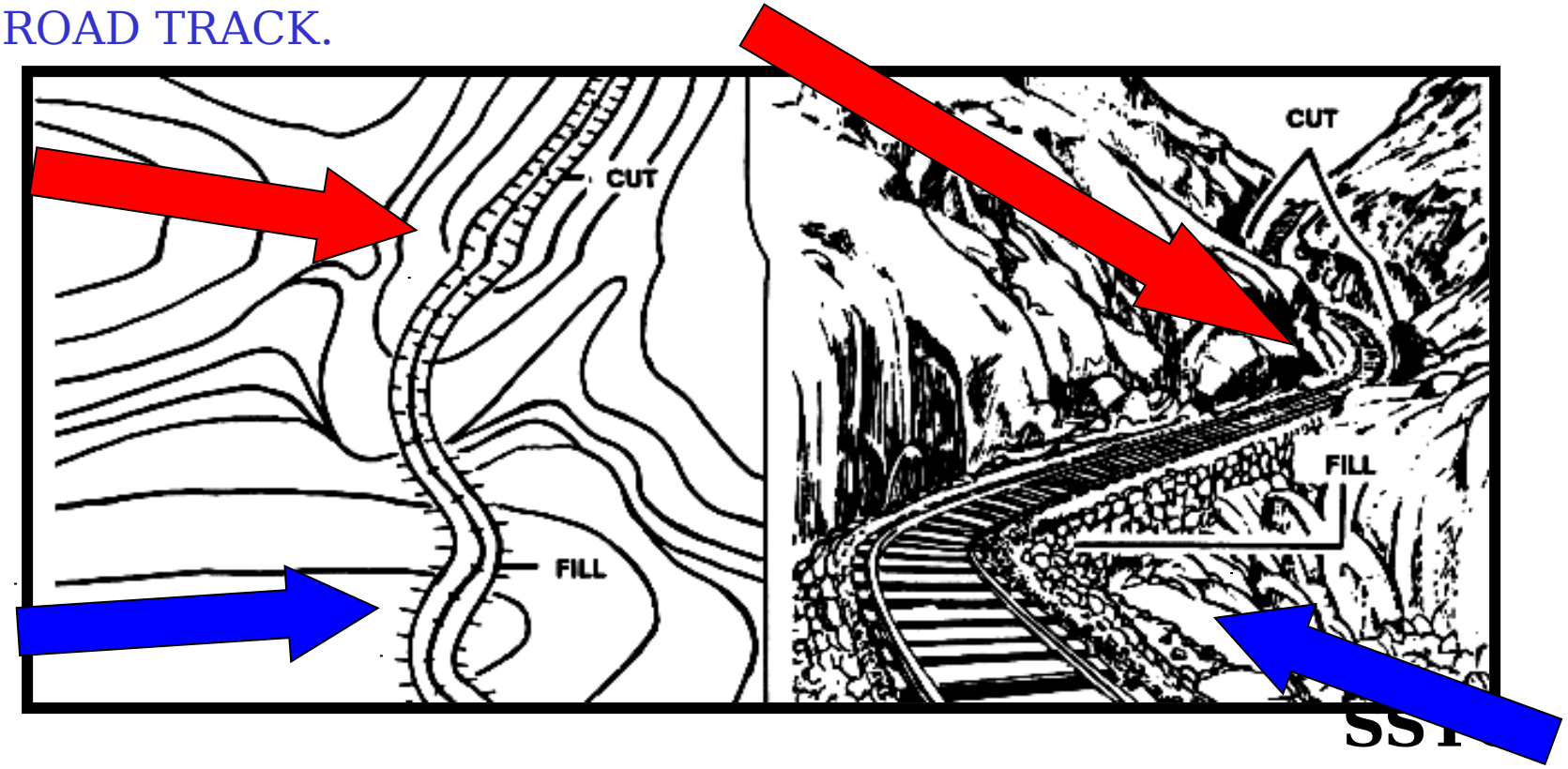
SSTC



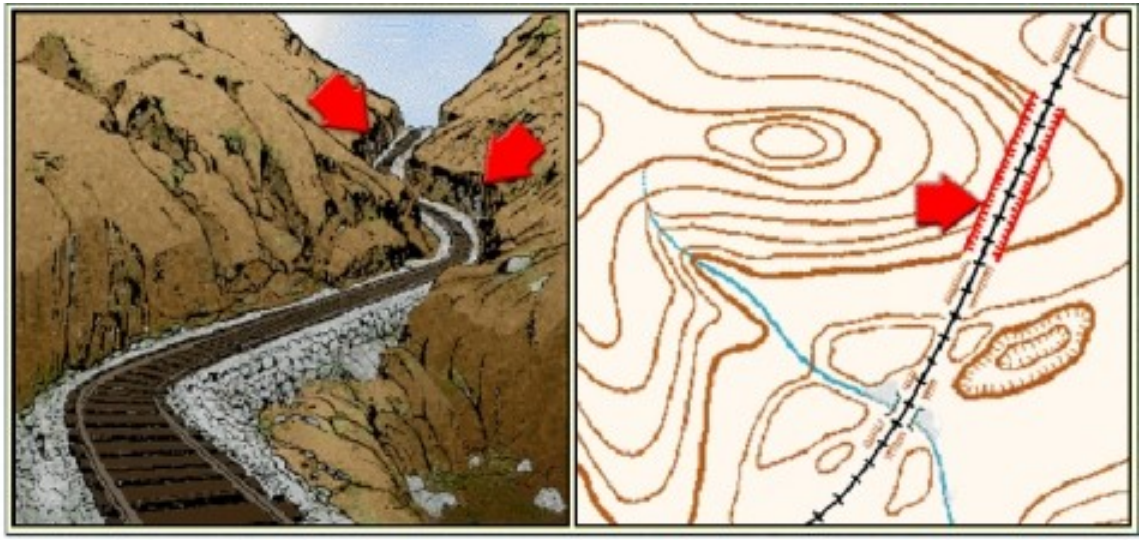
SSTC

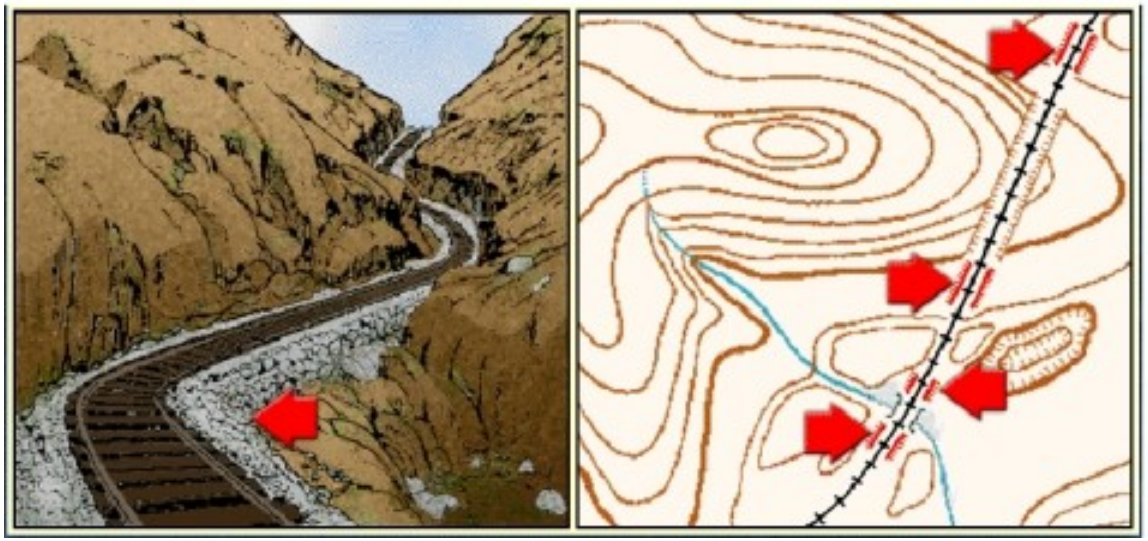
CUT: A MAN-MADE FEATURE RESULTING FROM CUTTING THROUGH RAISED GROUND, USUALLY TO FROM A LEVEL BED FOR A ROAD OR RAILROAD TRACK.

FILL: A MAN-MADE FEATURE RESULTING FROM FILLING A LOW AREA, USUALLY TO FORM A LEVEL BED FOR A ROAD OR RAIL-ROAD TRACK.



CUT

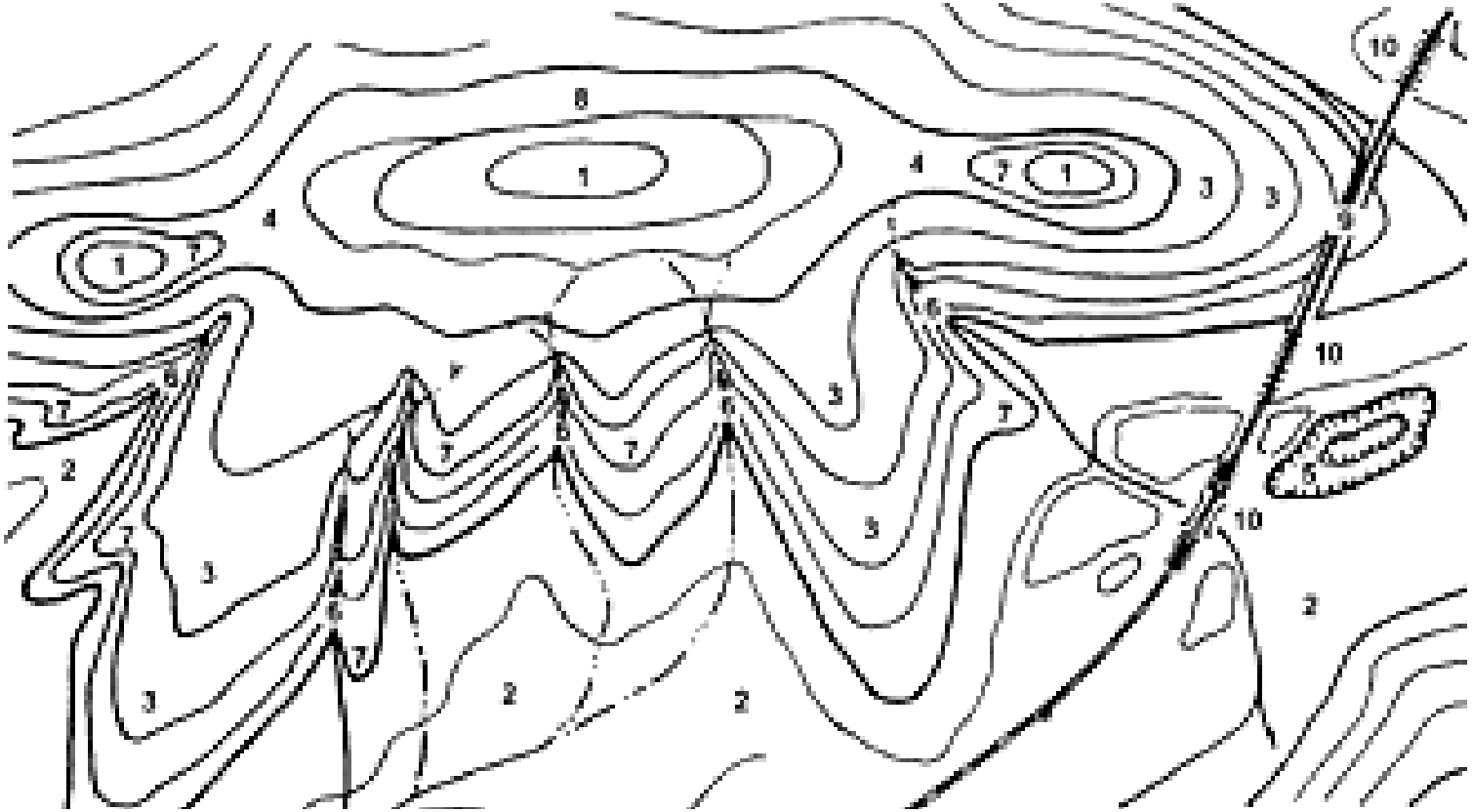




FILL

SSTC

Terrain Features



1. HILL
2. VALLEY
3. RIDGE
4. SADDLE
5. DEPRESSION
6. DRAW
7. SPUR
8. CLIFF
9. CUT
10. FILL

SSTC

TAKE A BREAK

Grid System…

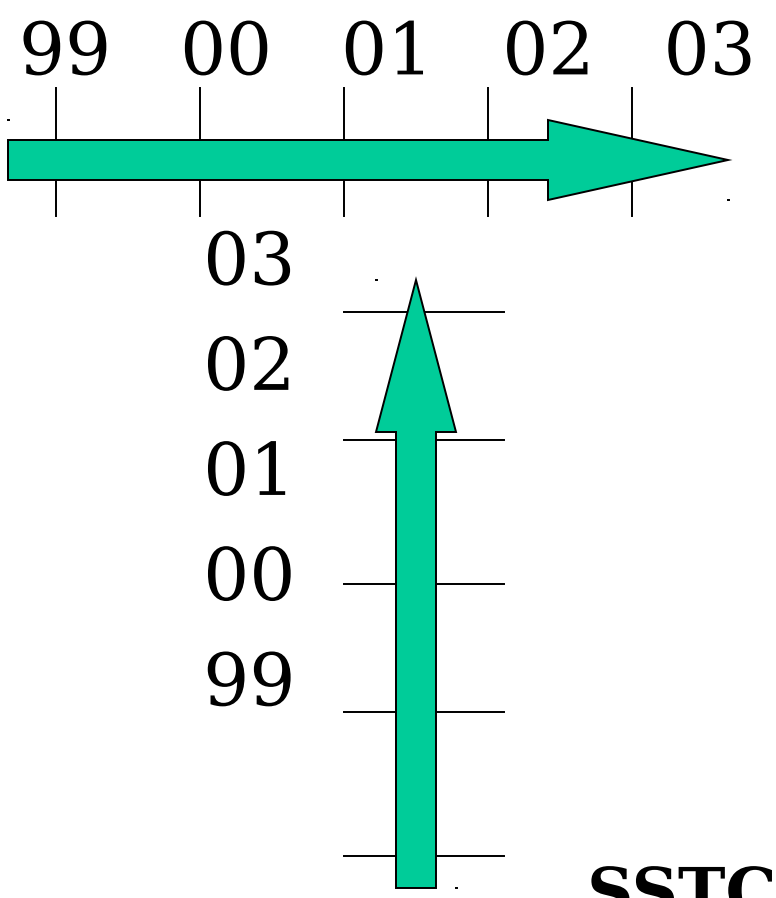
- Used to accurately locate/position objects on a map.
- Two sets of numbered parallel lines (vertical & horizontal) intersecting at right angles to form squares on a map.
- Superimposed over the map to provide a reference system.
- Grid squares are 1,000 $m^{2.}$

Grid References…

- North and South lines run up and down, numbered left to right.
- East and west lines run crosswise, numbered bottom to top.
- Read right first, then up.

TIP

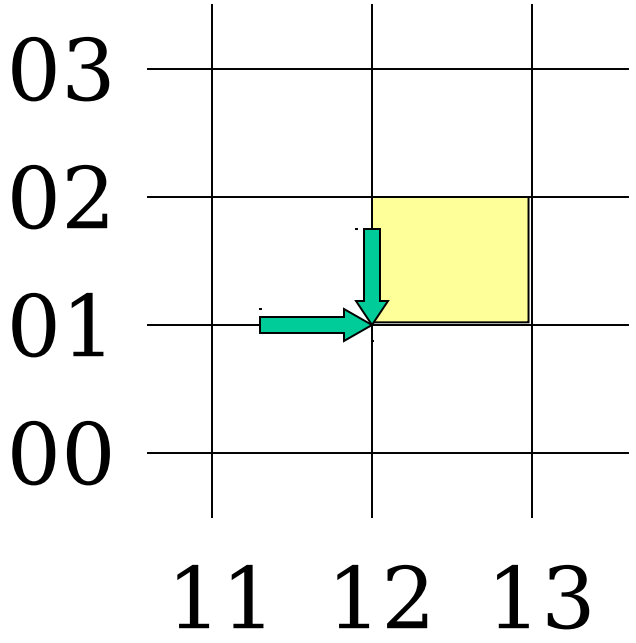
Read right first, then up.



SSTC

Grid Square…

- Find right 12 first.
- Then up 01.
- The coordinates represent the whole square, not just a single point.
- EH 1201 - represents 1,000 m^2



SSTC

Grid Square…

Determine the identity of each of the following:

1. **Name of the cemetery in grid square EG 1185**

   Forest Cemetery

2. **Name of the church in grid square EG 0385**

   Church of God

3. **Name of the lake in grid square EG 0895**

   Pitman Lake

4. **Name of the airport in grid square EH 0701**

   Olympia Municipal Airport

5. **Name of the school in grid square EH 0703**

THE MILITARY PROTRACTOR

BASE LINE

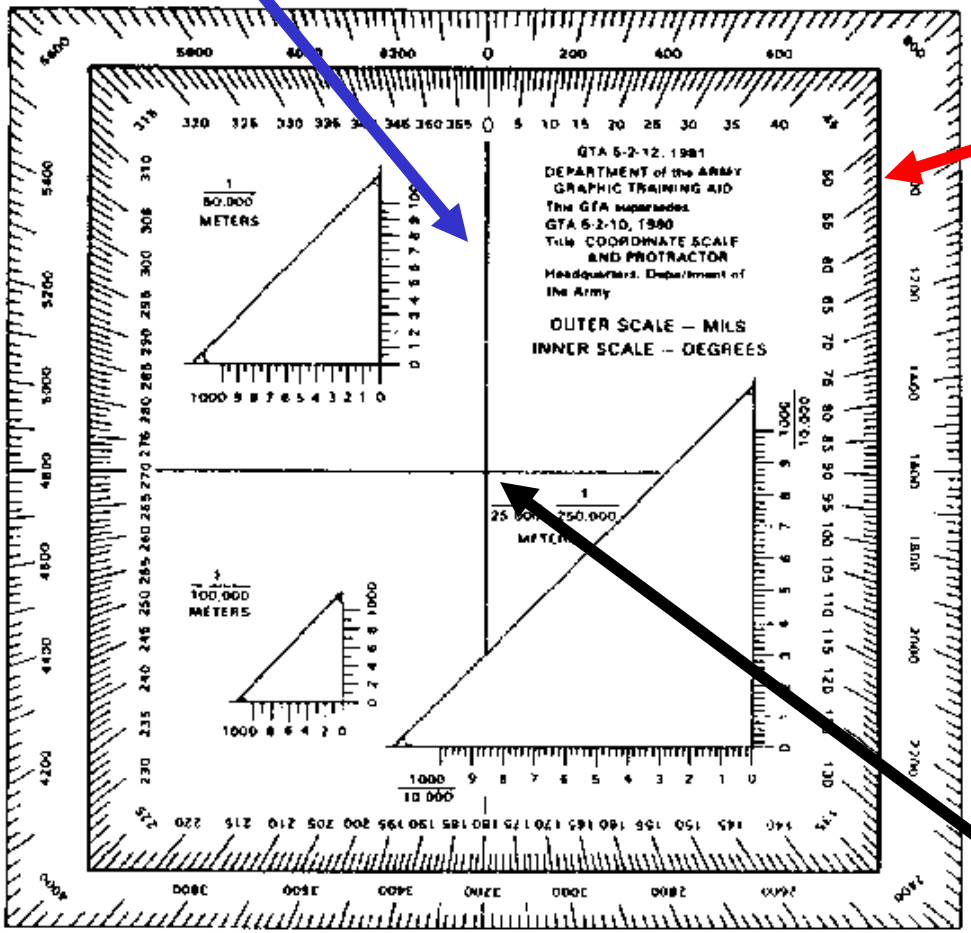


Figure 4-14. Coordinate scales.

DEGREES

MILS

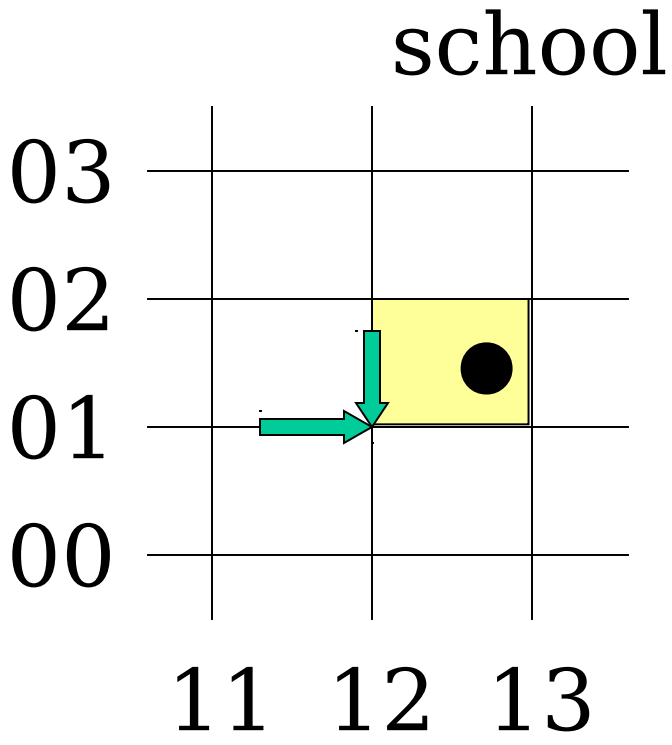
THE GTA 5-2-12 IS THE MOST COMMONLY USED PROTRACTOR FOR MAP READING.

INDEX

SSTC

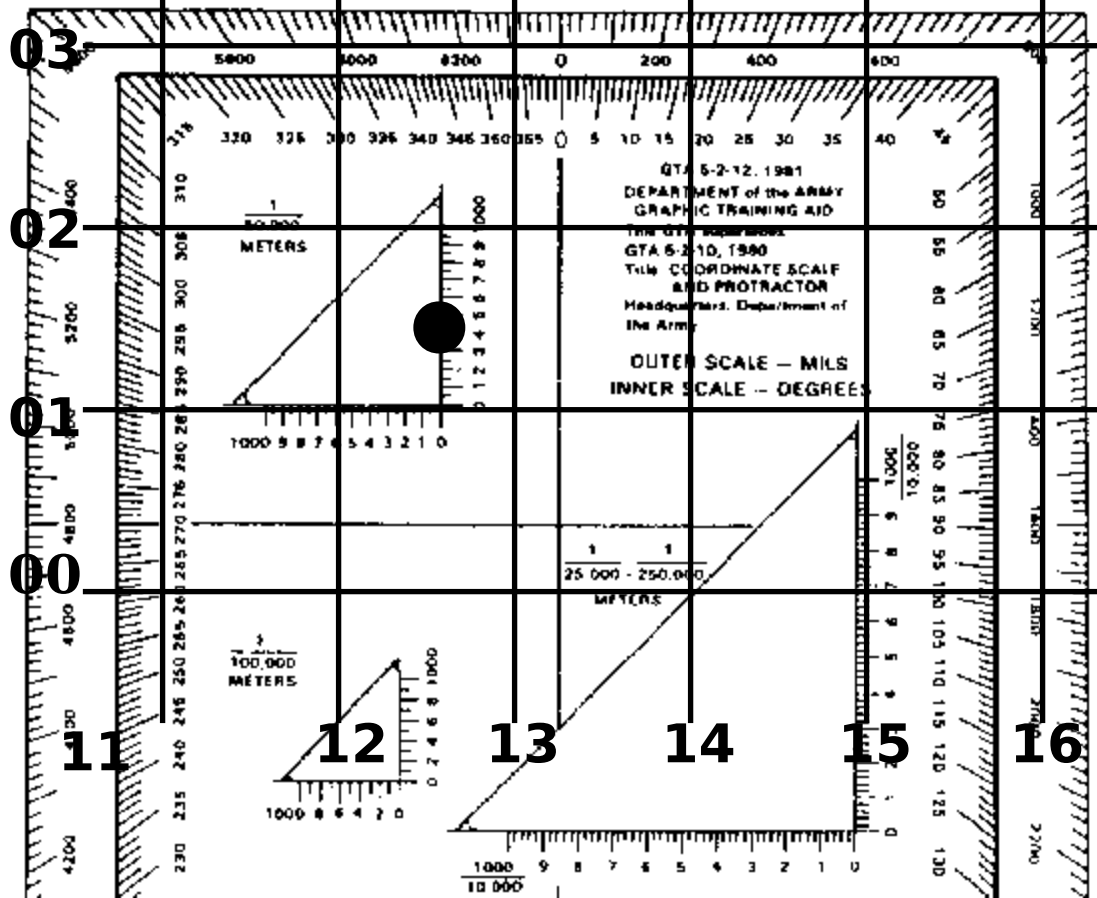
6-Digit Coordinate

- Find right 12 first.
- Then up 01.
- Then place the horizontal portion of the protractor along the east-west grid line at the lower left-hand corner of the grid square, then slide it right until the vertical scales cut the center of the object.
- EH 12_ 01_



SSTC

Locate a 6 digit grid



05

04

03

02

01

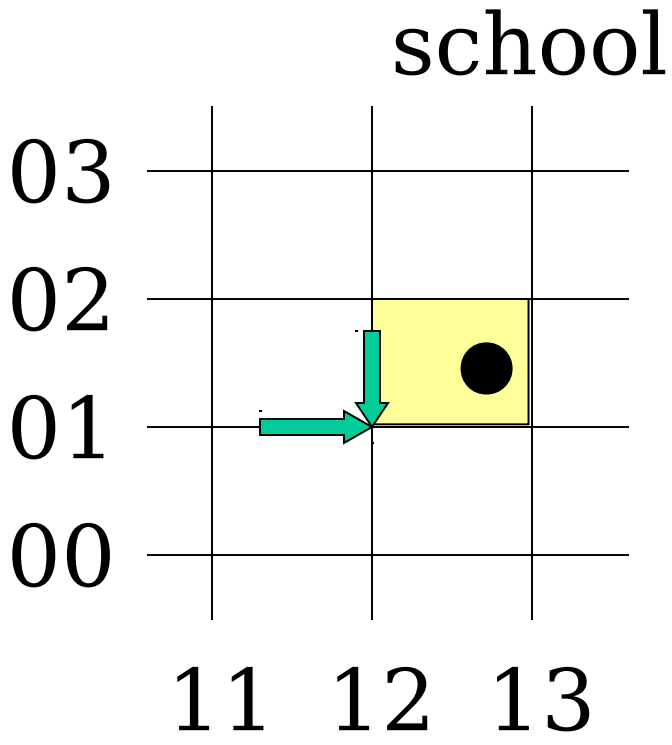
00

11 12 13 14 15 16 17 18 19

SSTC

6-Digit Coordinate

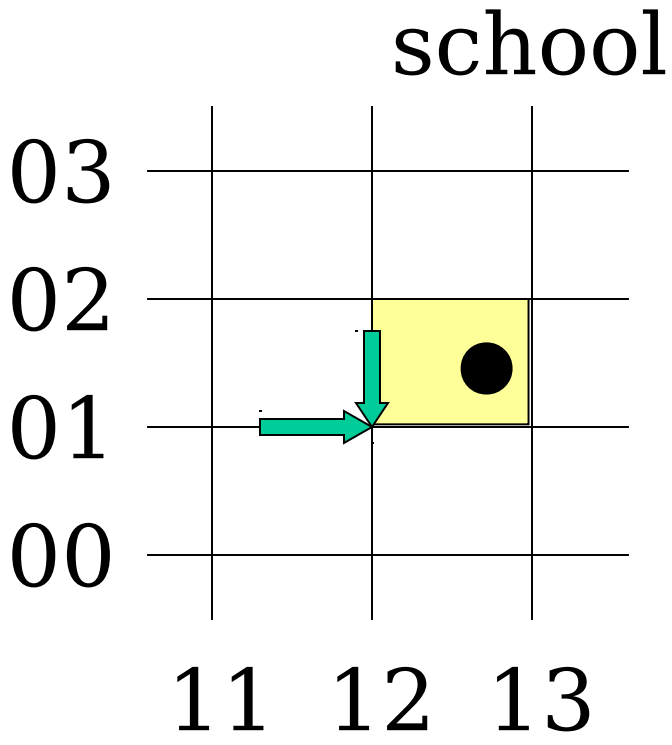
- The hundredths reading on the east-west grid line is your third digit.
- The hundredths reading on the north-south line is your sixth digit.
- EH 126 015



SSTC

8-Digit Coordinate

EH 1262 0150



SSTC

TAKE A BREAK

Methods of Showing Elevation

- Elevation
  - The reference or start point for vertical measurement of elevation on a standard military map are the datum plane or mean sea level, the point on the earth's surface is the vertical distance it is above or below mean sea level. Relief is the representation (as depicted by the mapmaker) of the shapes of hills, valleys, streams, or terrain features on the earth's surface.

Contour lines

- Index
  - Starting at zero elevation or mean sea level, every fifth contour line is a heavier line. These are known as index contour lines. Normally, each index contour line is numbered at some point. This number is the elevation of that line.

Contour lines

- Intermediate
  - The contour lines falling between the index contour lines are called intermediate contour lines. The lines are finer and do not have their elevations given. There are normally four intermediate contour lines between index contour lines.

Contour lines

- Supplementary
  - These contour lines resemble dashes they show changes in elevation of at least one-half the contour interval. These lines are normally found where there is very little change in elevation, such as on fairly level terrain.

Contour Lines

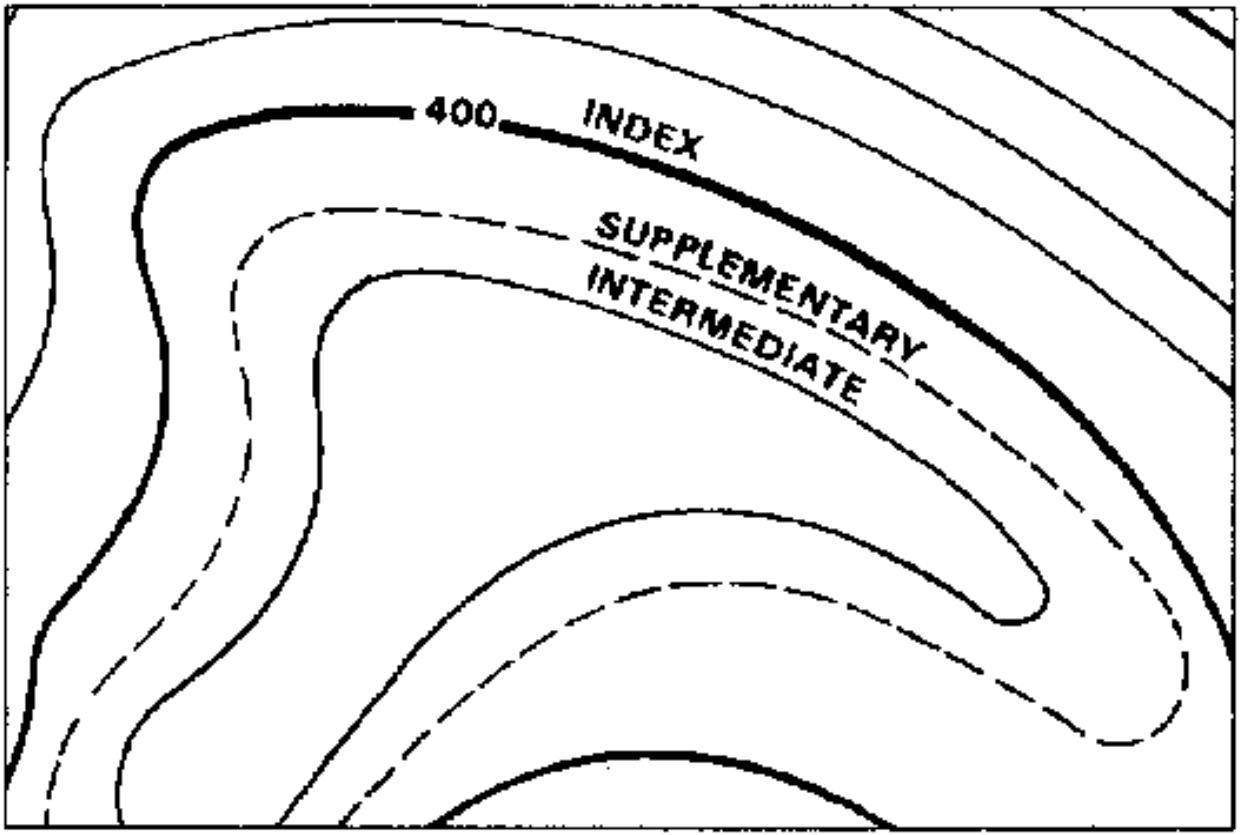


Figure 10-1. Contour lines.

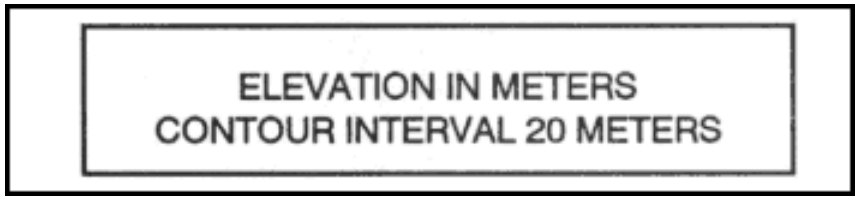
SSTC

Contour Intervals

Before the elevation of any point on the map can be determined, the user must know the contour interval for the map he or she is using. The contour interval measurement given in the marginal information is the vertical distance between adjacent contour lines. To determine the elevation of a point on the map--

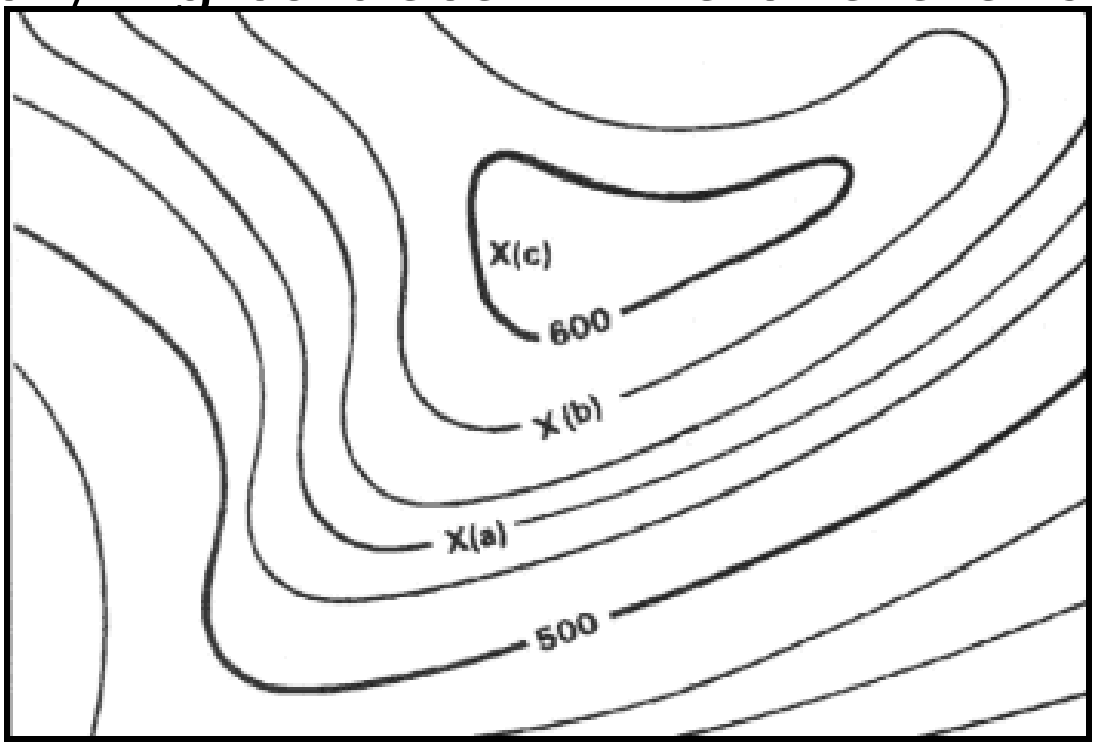
Contour Intervals

a. Determine the contour interval and the unit of measure used, for example, feet, meters, or yards.



Contour Intervals

b. Find the numbered index contour line nearest the point of which you are trying to determine the elevation.



SSTC

Contour Intervals

c. Determine if you are going from lower elevation to higher, or vice versa. In Figure 10-3, point (a) is between the index
conto
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index
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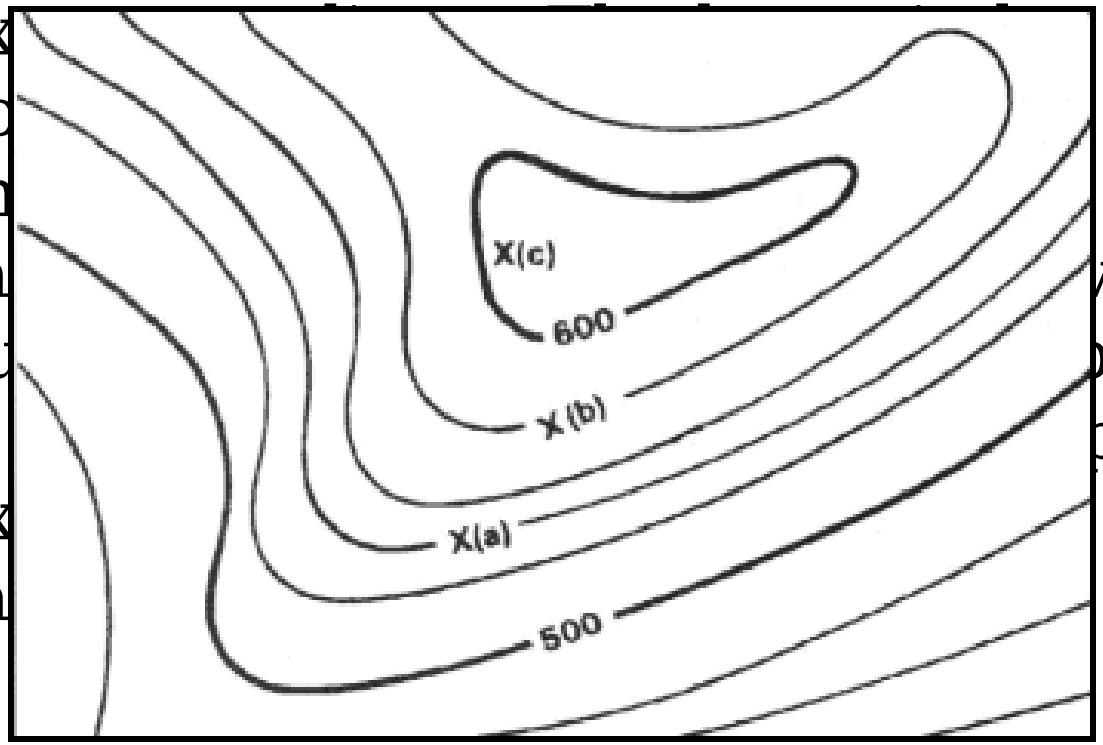

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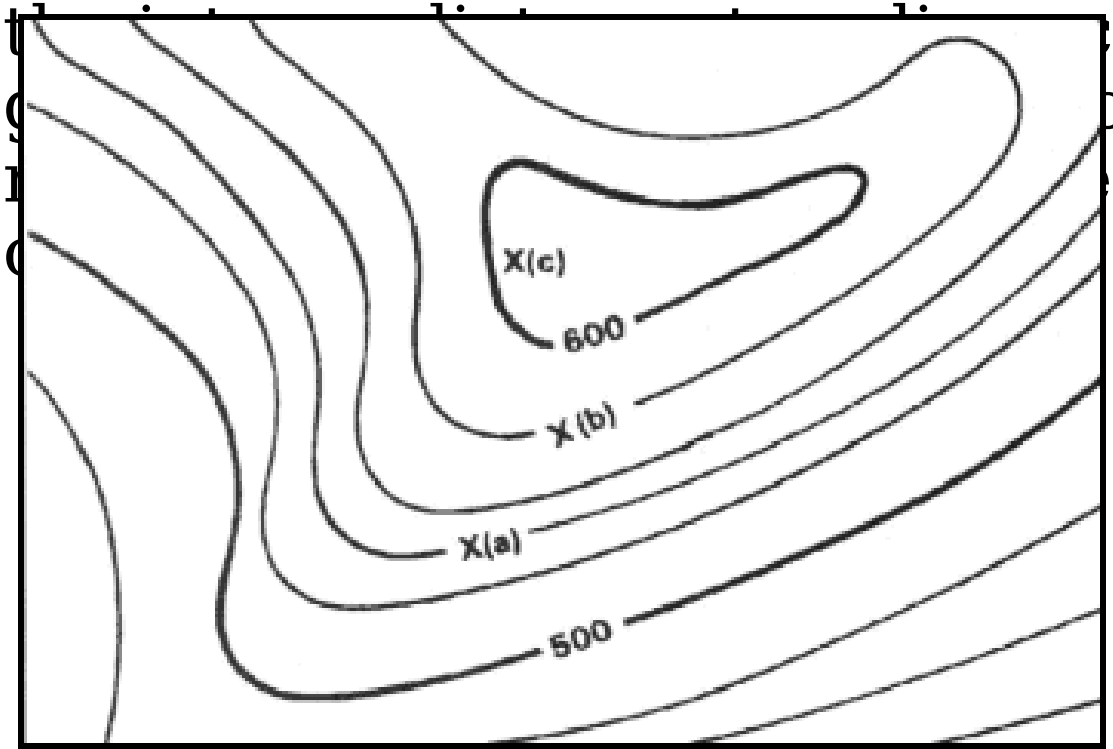
SSTC

Contour Intervals

d. Determine the exact elevation of point (a), start at the index contour line numbered 500 and count the number of intermediate contour lines to point (a). Locate point (a) on the second intermediate contour line above the 500-meter index contour line. The contour interval is 20 meters, thus each one of t rossed to g o the 500-m levation o



SSTC

Contour Intervals

e. Determine the elevation of point (b). Go to the nearest index contour line. In this case, it is the upper index contour line numbered 600. Locate point (b) on the intermediate contour line immediately below the 600-meter index contour line. Belo
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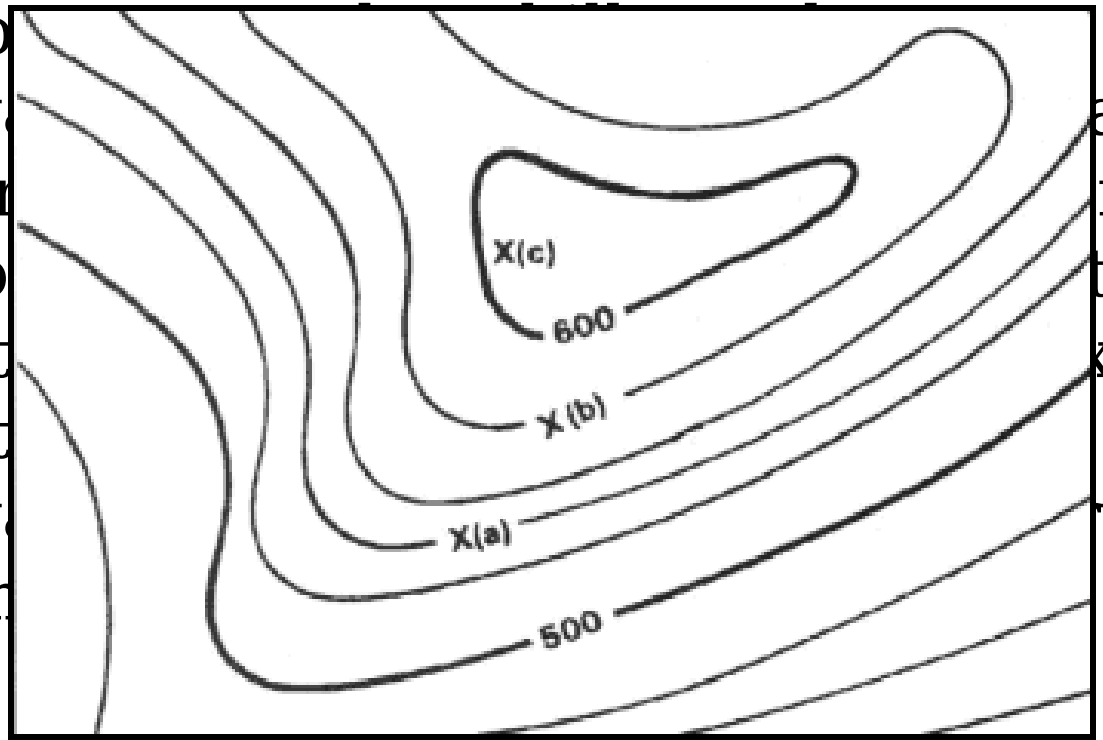
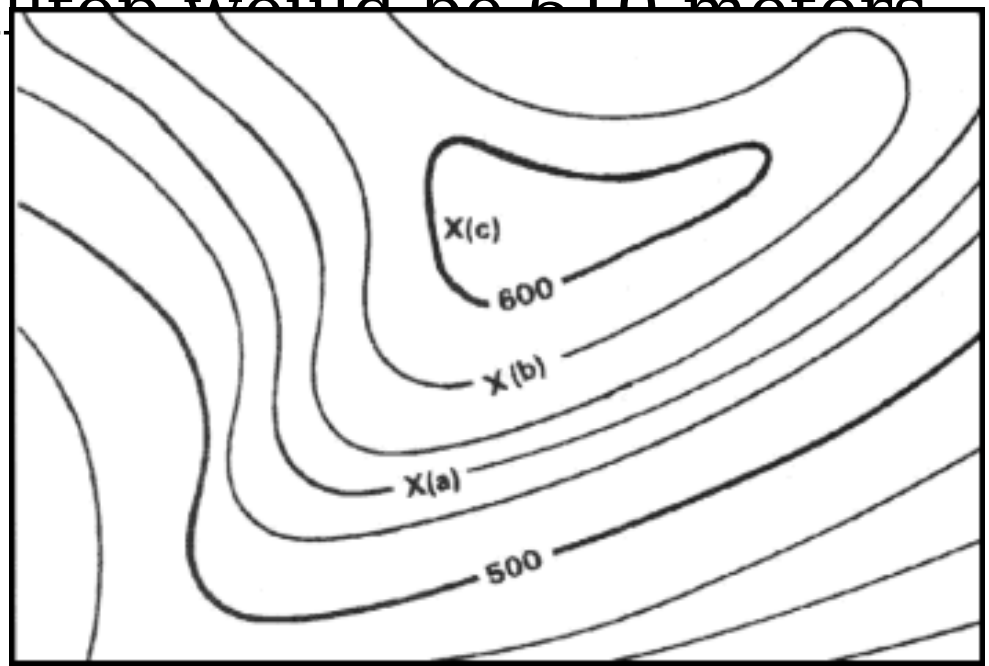


Contour Intervals

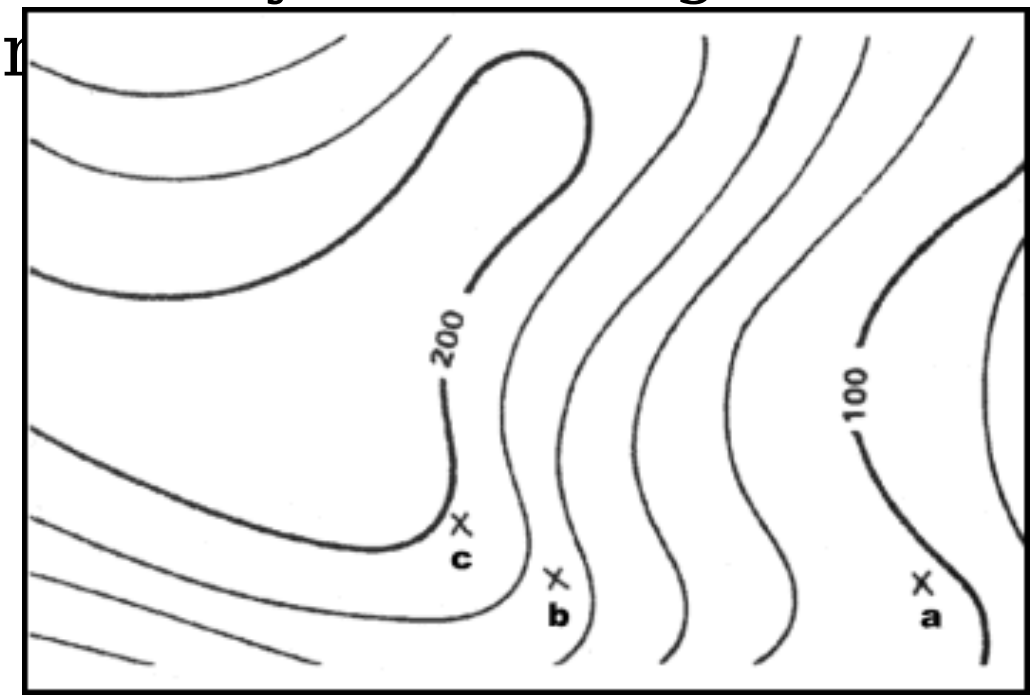
f. Determine the elevation to a hilltop point (c). Add one-half the contour interval to the elevation of the last contour line. In this example, the last contour line before the hilltop is an index contour line numbered 600. Add one-half the contour interval, 10 meters, to the index contour line. The elevation of the hilltop would be 610 meters.



SSTC

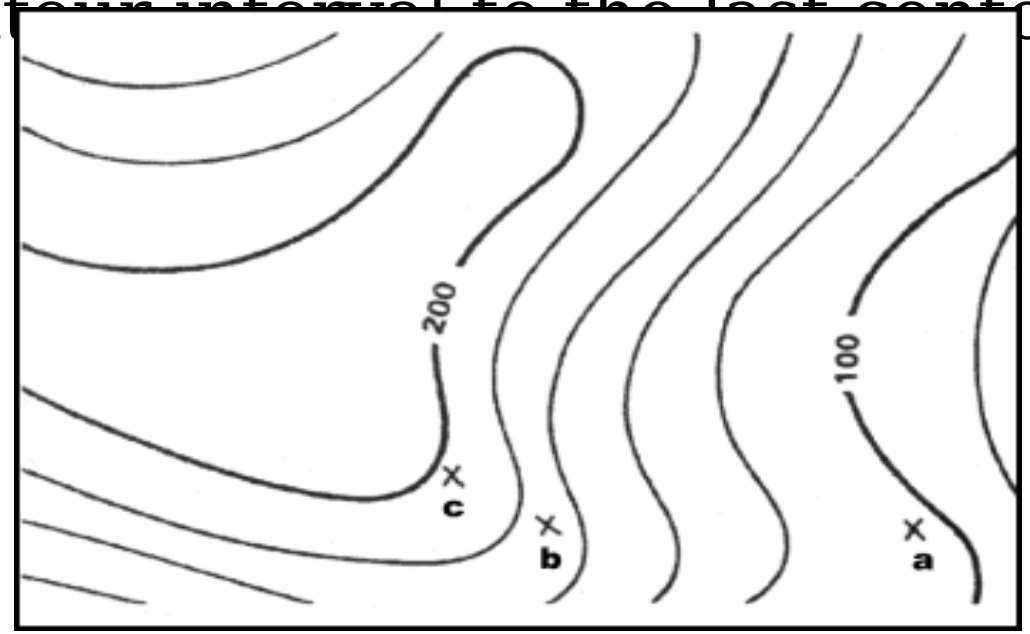
Contour Intervals

g. There may be times when you need to determine the elevation of points to a greater accuracy. To do this, you must determine how far between the two contour lines the point lies. However, most military needs are satisfied by estimating the elevation of poi



Contour Intervals

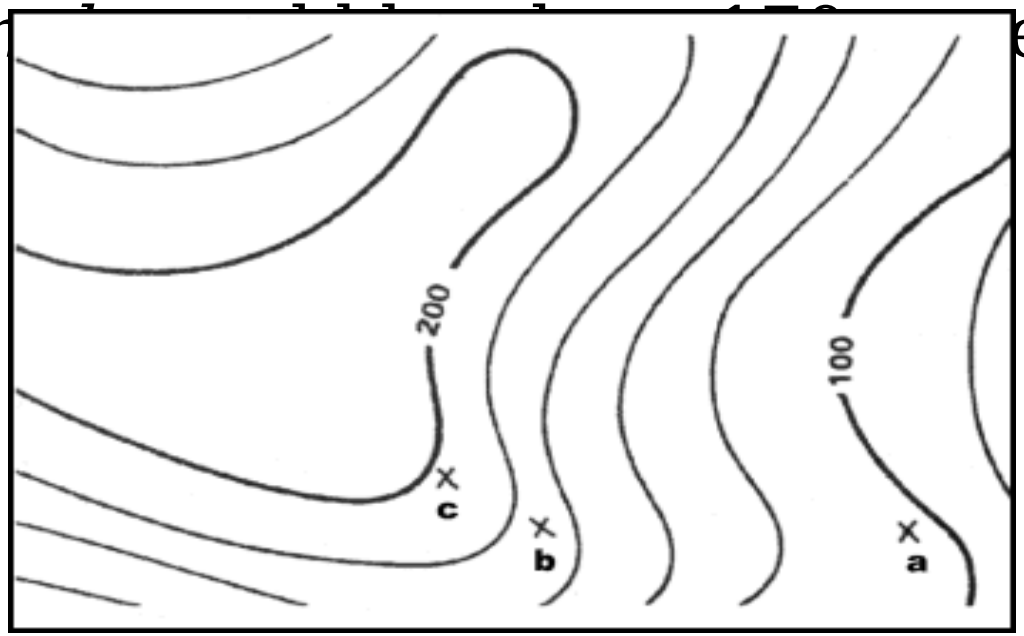
(1) If the point is less than one-fourth the distance between contour lines, the elevation will be the same as the last contour line. The elevation of *point a* will be 100 meters. To estimate the elevation of a point between one-fourth and three-fourths of the distance between contour lines, add one-half the contour interval to the last contour line.



SSTC

Contour Intervals

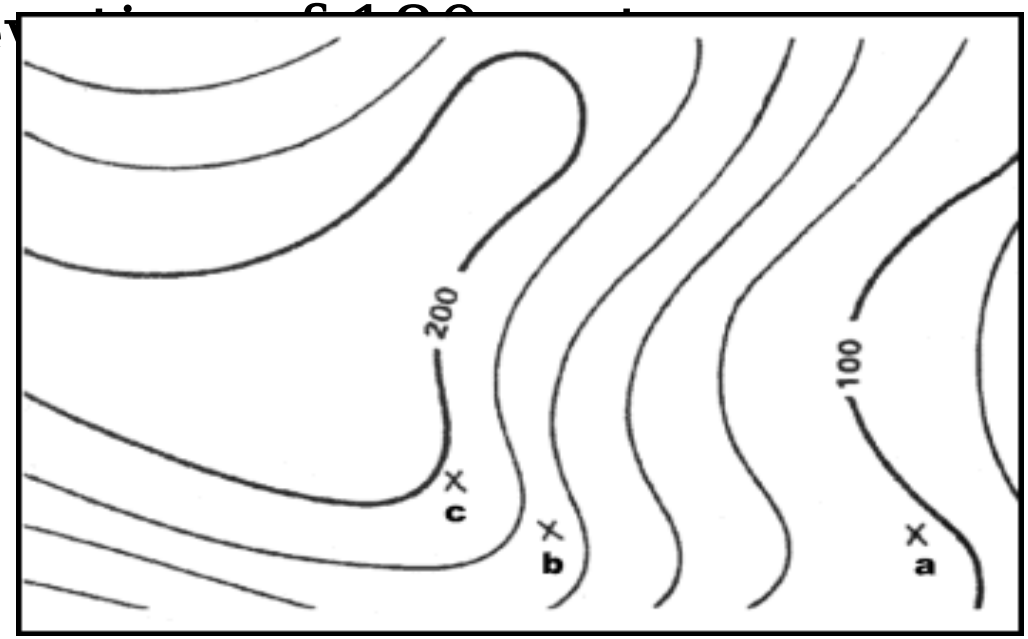
(2) *Point b* is one-half the distance between contour lines. The contour line immediately below *point b* is at an elevation of 160 meters. The contour interval is 20 meters; thus one-half the contour interval is 10 meters. In this case, add 10 meters to the last contour line of 160 meters. The elevation of *poin*ers.



SSTC

Contour Intervals

(3) A point located more than three-fourths of the distance between contour lines is considered to be at the same elevation as the next contour line. *Point c* is located three-fourths of the distance between contour lines. *Point c* would be considered to be at an ele

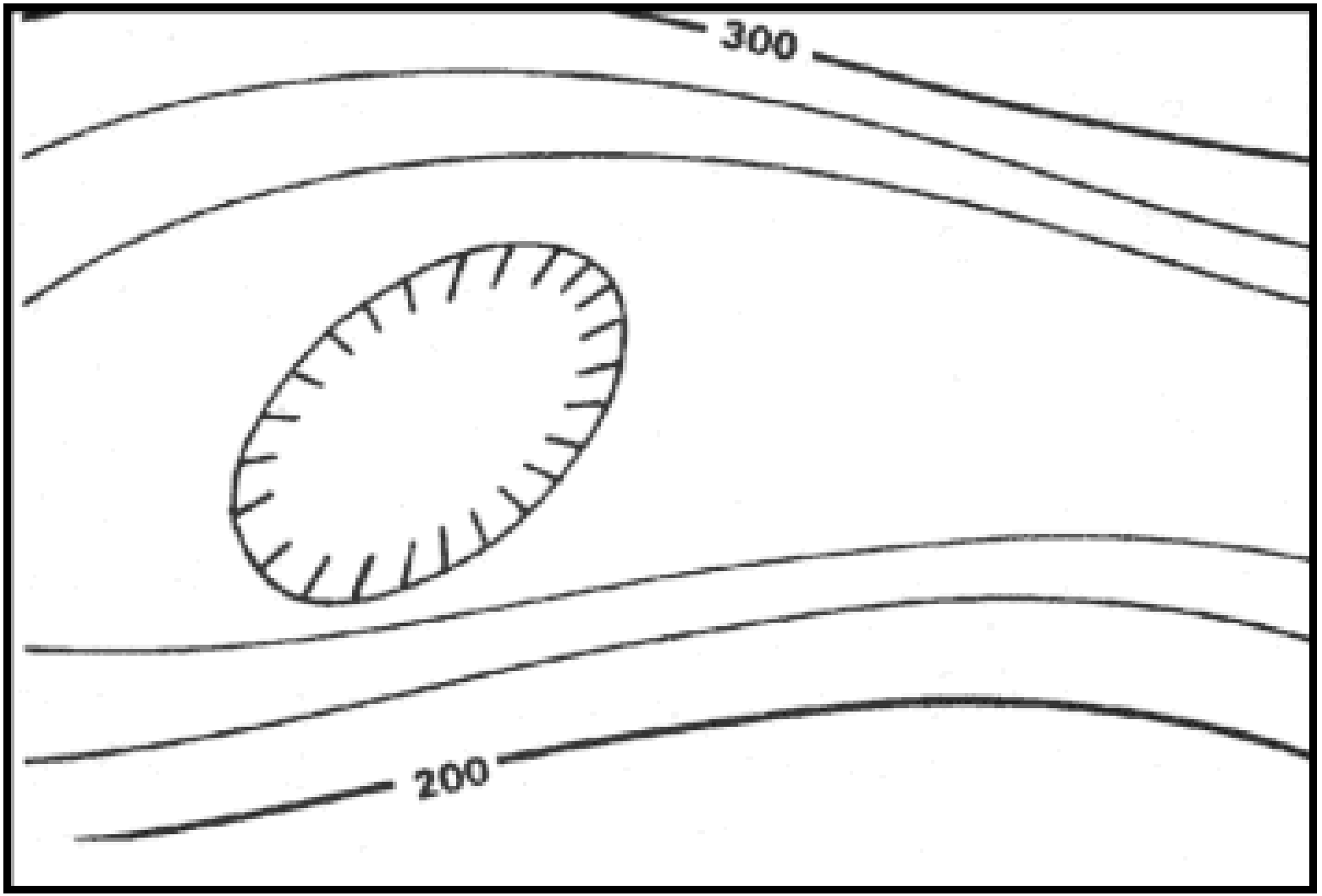


SSTC

Contour Intervals

h. To estimate the elevation to the bottom of a depression, subtract one-half the contour interval from the value of the lowest contour line before the depression. In Figure 10-5, the lowest contour line before the depression is 240 meters in elevation. Thus, the elevation at the edge of the depression is 240 meters. To determine the elevation at the bottom of the depression, subtract one-half the contour interval. The contour interval for this example is 20 meters. Subtract 10 meters from the lowest contour line immediately before the depression. The result is that the elevation at the bottom of the depression is 230 meters. The tick marks on the contour line forming a depression always point to lower elevations.

Contour Intervals



SSTC

Contour Intervals

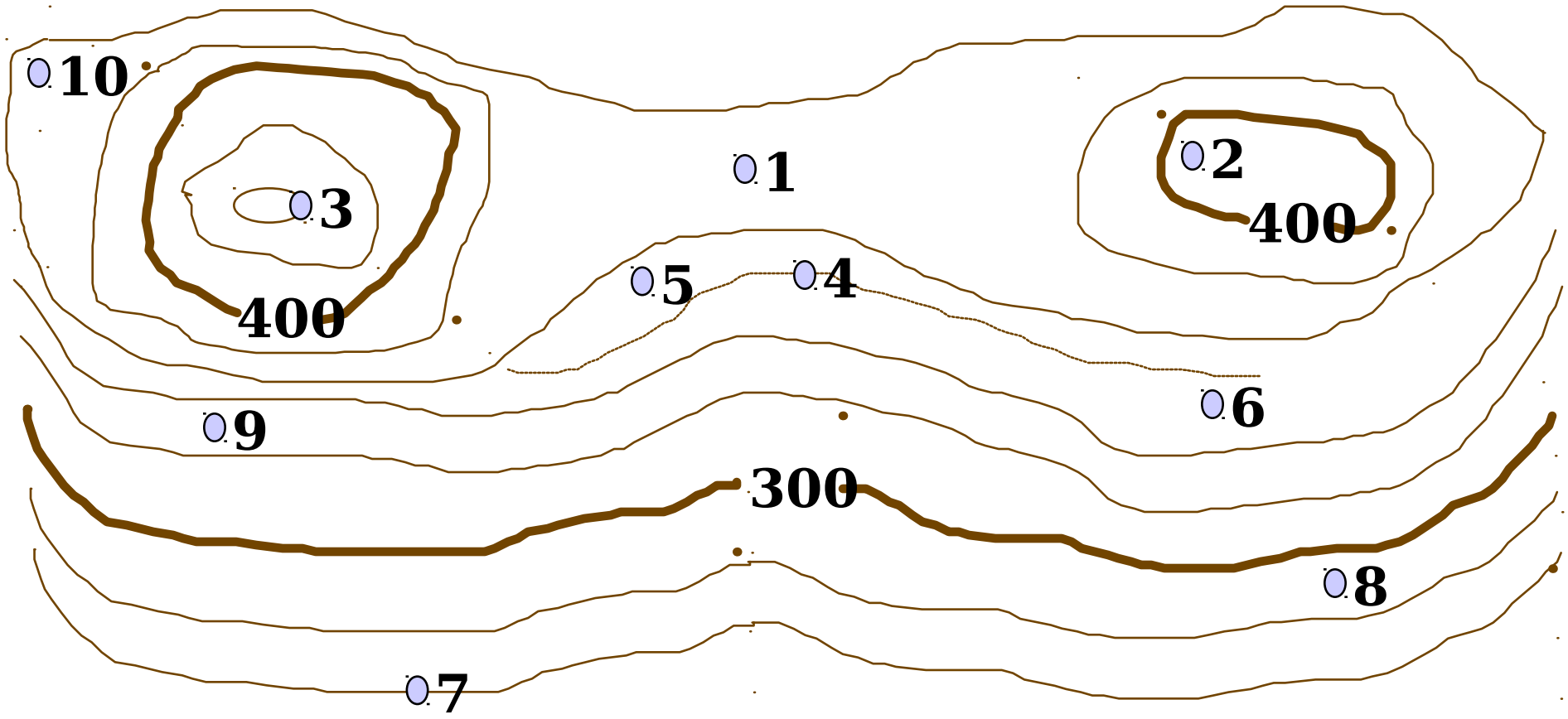
i. In addition to the contour lines, bench marks and spot elevations are used to indicate points of known elevations on the map.

(1) Bench marks, the more accurate of the two, are symbolized by a black X, such as X BM 214. The 214 indicates that the center of the X is at an elevation of 214 units of measure (feet, meters, or yards) above mean sea level. To determine the units of measure, refer to the contour interval in the marginal information.

(2) Spot elevations are shown by a brown X and are usually located at road junctions and on hilltops and other prominent terrain features. If the elevation is shown in black numerals, it has been checked for accuracy; if it is in brown, it has not been checked.

NOTE: New maps are being printed using a dot instead of brown Xs.

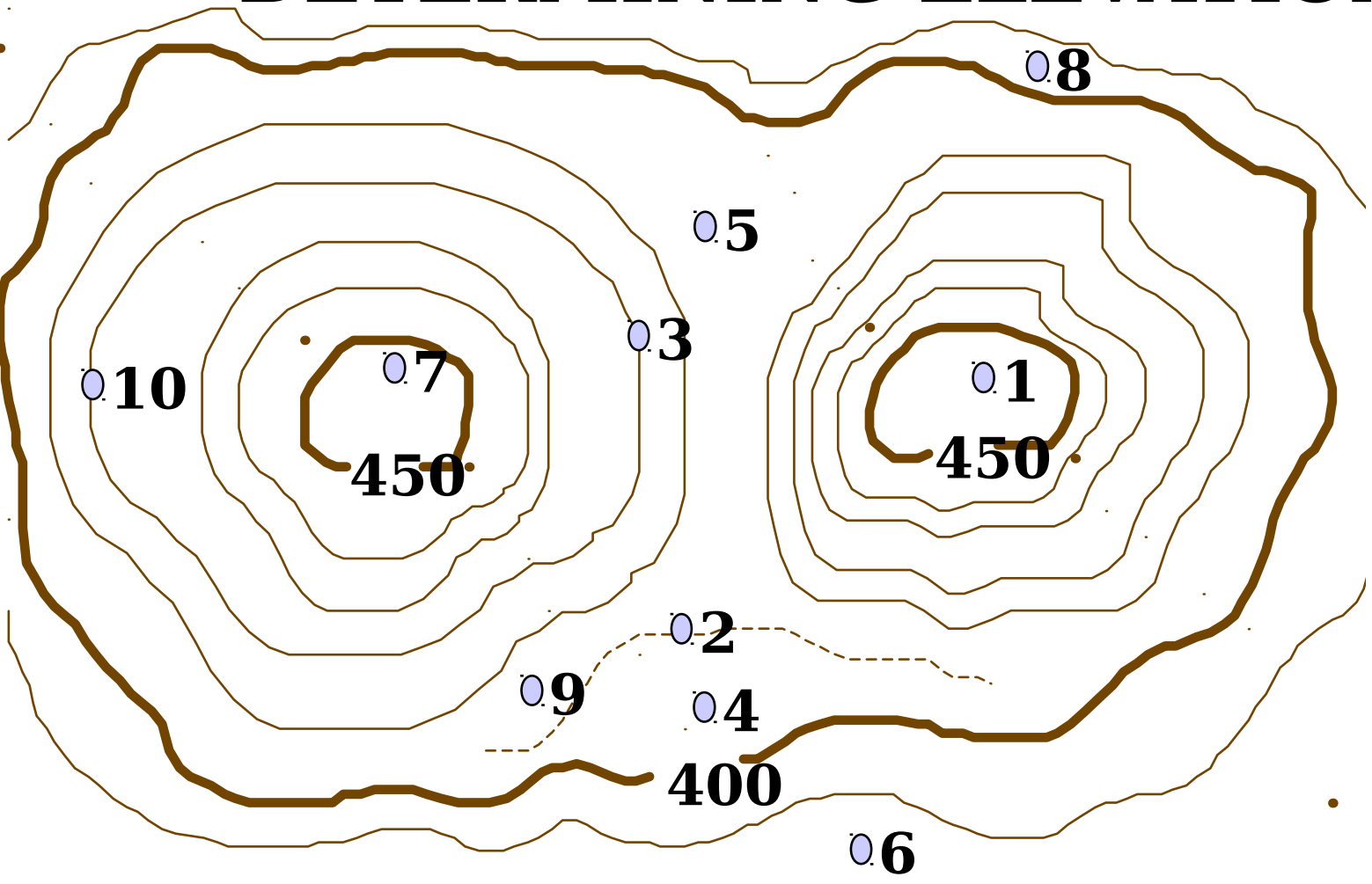
DETERMINING ELEVATION
CONTOUR INTERVAL IS 20M



1. 370 2. 410 3. 440 4. 350 5. 355 6. 345 7. 260
8. 290 9. 330 10. 370

SSTC

DETERMINING ELEVATION



1. 455
2. 405
3. 420
4. 402
5. 405
6. 385
7. 455
8. 395
9. 407.5
10. 420

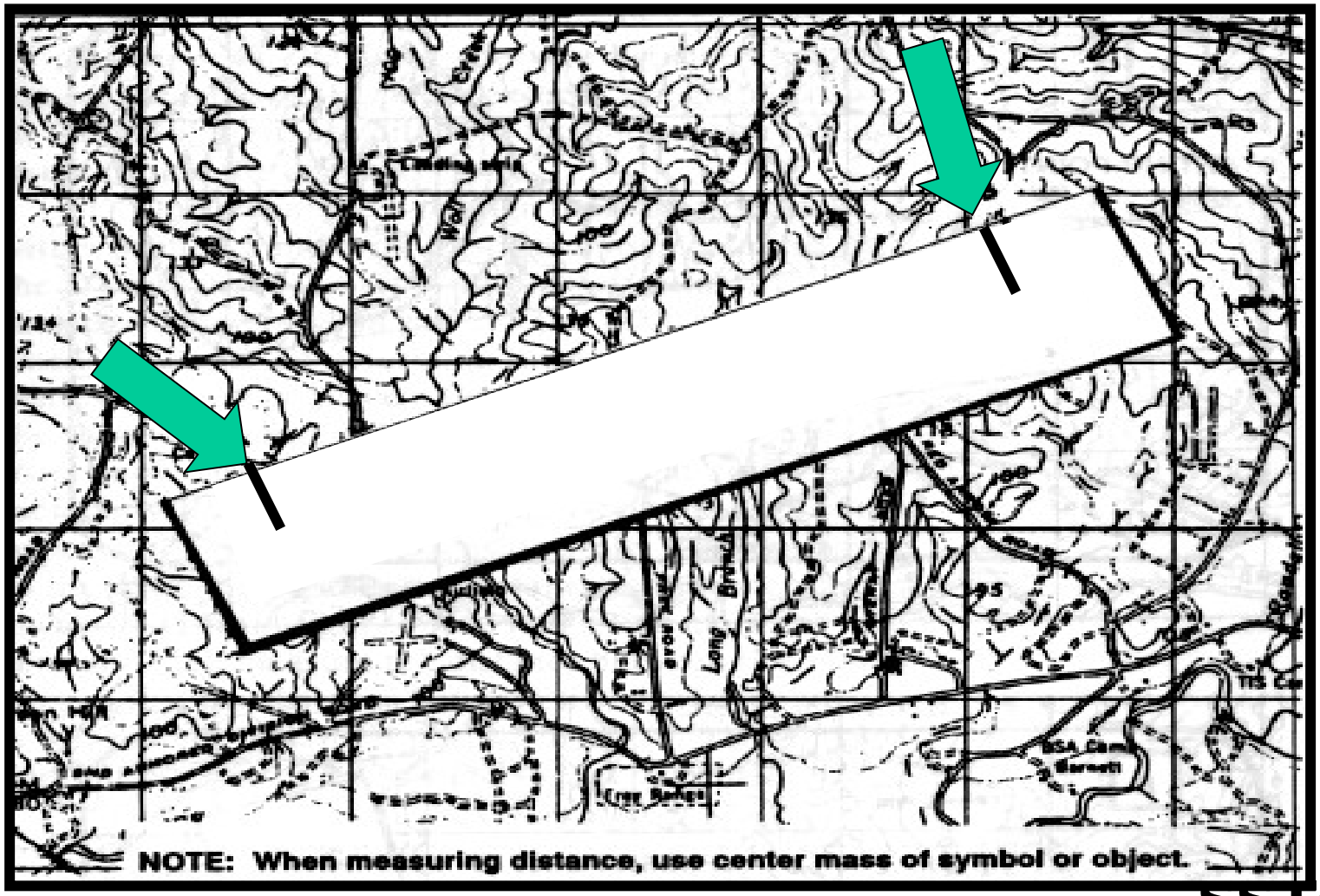
CONTOUR INTERVAL IS 10 METERS

SSTC

STRAIGHT-LINE DISTANCE

To determine straight-line distance between two points on a map, lay a straight-edged piece of paper on the map so that the edge of the paper touches both points and extends past them. Make a tick mark on the edge of the paper at each point.

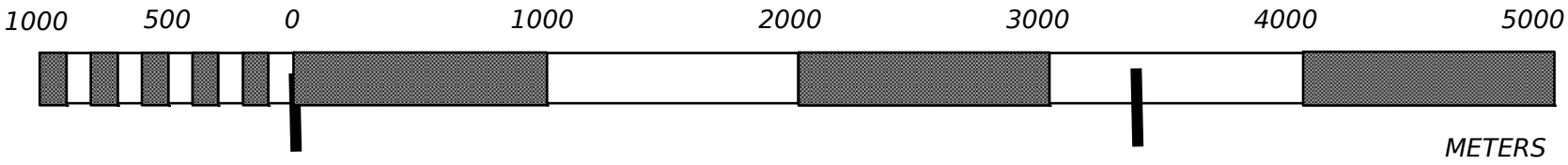
STRAIGHT-LINE DISTANCE



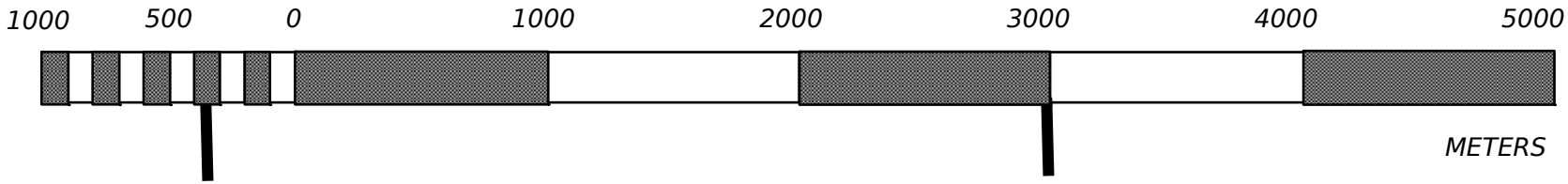
SSTC

STRAIGHT-LINE DISTANCE

To convert the map distance to ground distance, move the paper down to the graphic bar scale, and align the right tick mark with a printed number in the primary scale so that the left tick mark is in the extension scale



SSTC



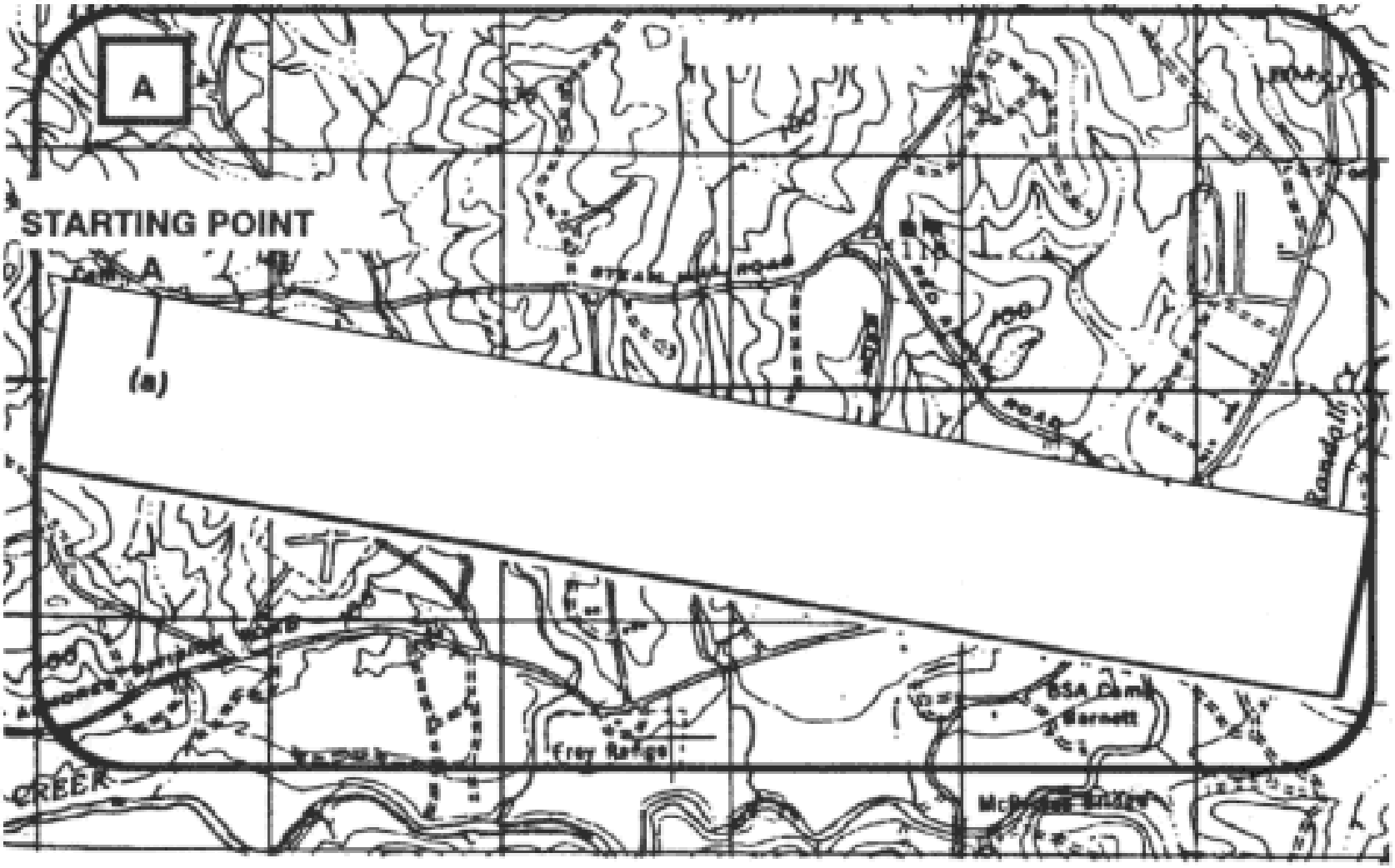
3350 meters

SSTC

CURVED-LINE DISTANCE

To measure distance along a road, stream, or other curved line, the straight edge of a piece of paper is used. In order to avoid confusion concerning the point to begin measuring from and the ending point, an eight-digit coordinate should be given for both the starting and ending points. Place a tick mark on the paper and map at the beginning point from which the curved line is to be measured. Align the edge of the paper along a straight portion and make a tick mark

CURVED-LINE DISTANCE

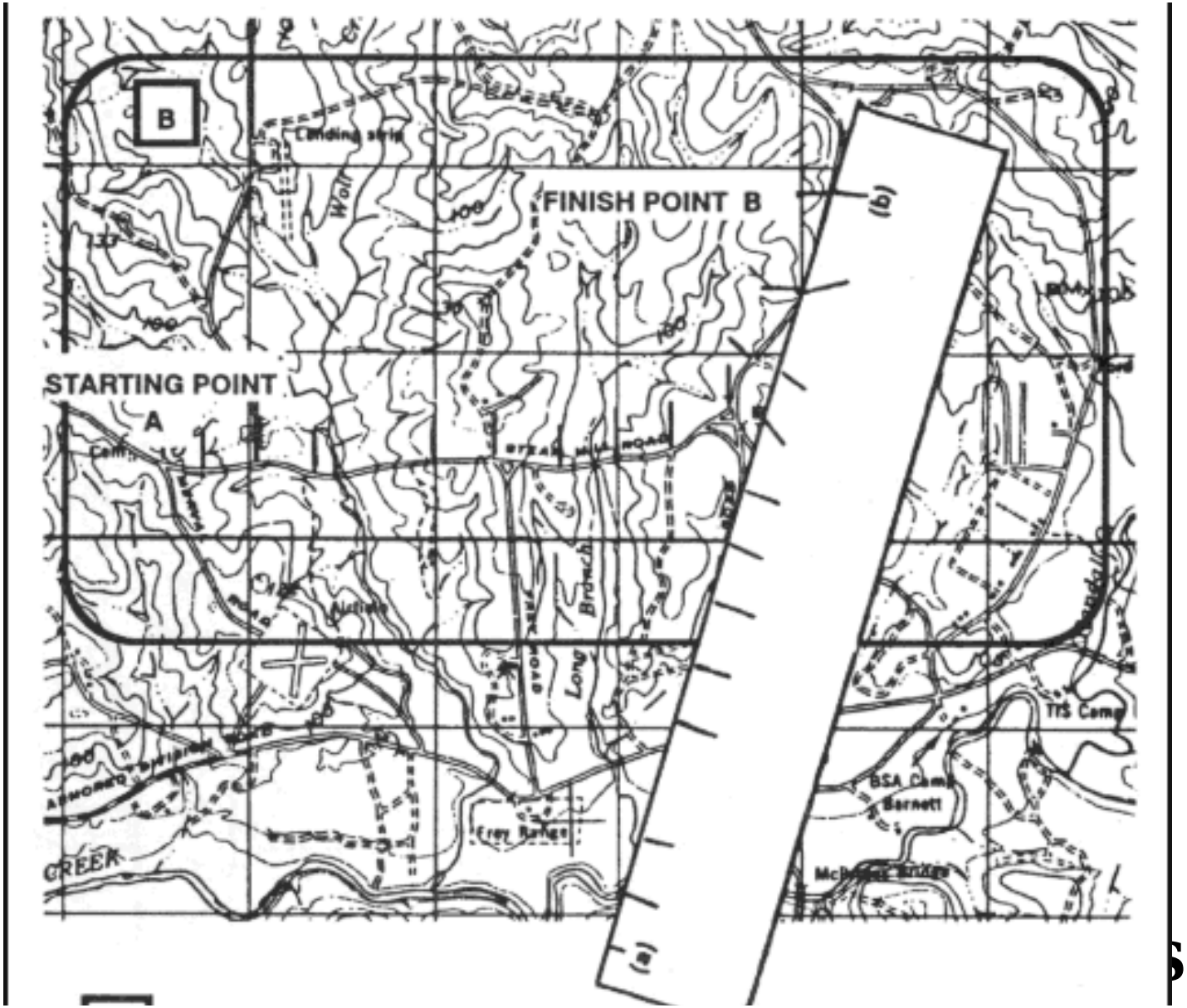


SSTC

CURVED-LINE DISTANCE

Keeping both tick marks together (on paper and map), place the point of the pencil close to the edge of the paper on the tick mark to hold it in place and pivot the paper until another straight portion of the curved line is aligned with the edge of the paper. Continue in this manner until the measurement is completed.

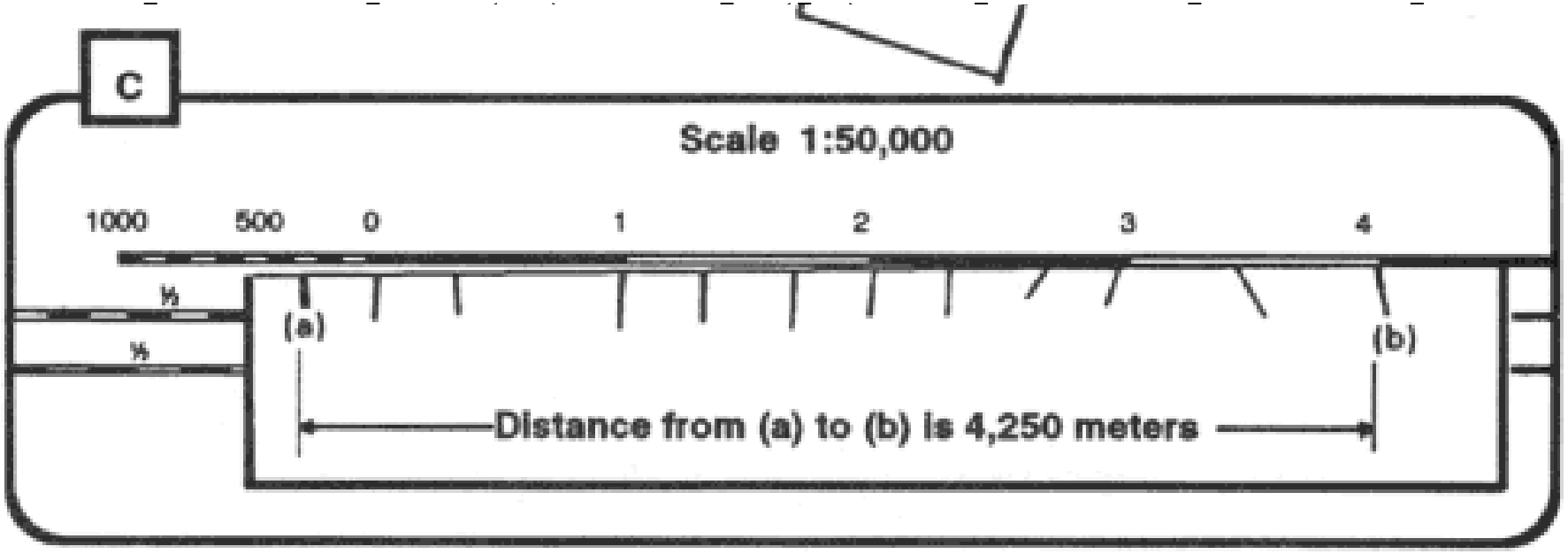
CURVED-LINE DISTANCE



SSTC

CURVED-LINE DISTANCE

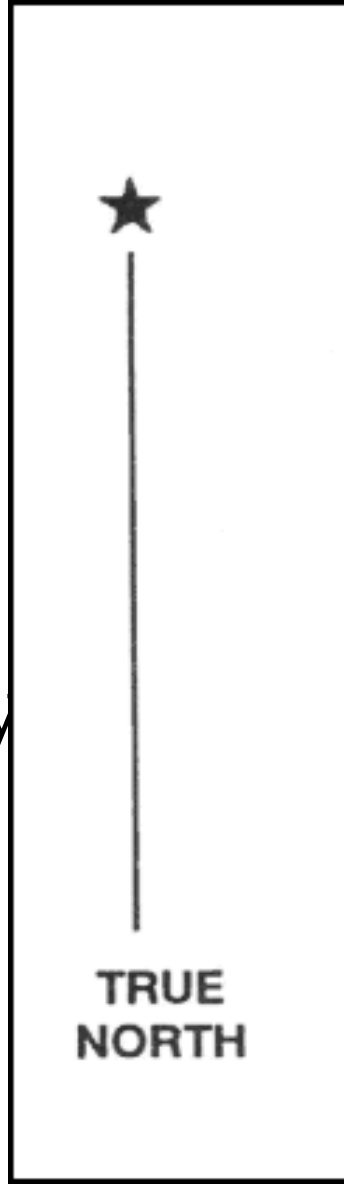
When you have completed measuring the distance, move the paper to the graphic scale to determine the ground distance. The only tick marks you will be measuring the distance between are



3 Norths

True North

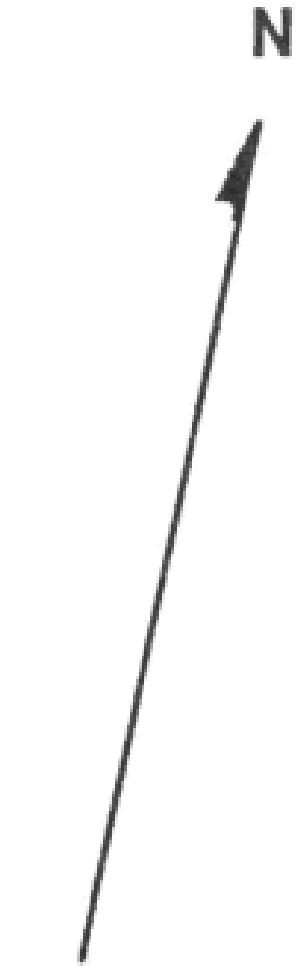
- A line from any point on the earth's surface to the north pole. All lines of longitude are true north lines. True north is usually represented by a star.



3 Norths

Magnetic North

- The direction to the north magnetic pole, as indicated by the north-seeking needle of a magnetic instrument. The magnetic north is usually symbolized by a line ending with half of an arrowhead. Magnetic readings are obtained with magnetic instruments, such as lensatic and M2 compasses.



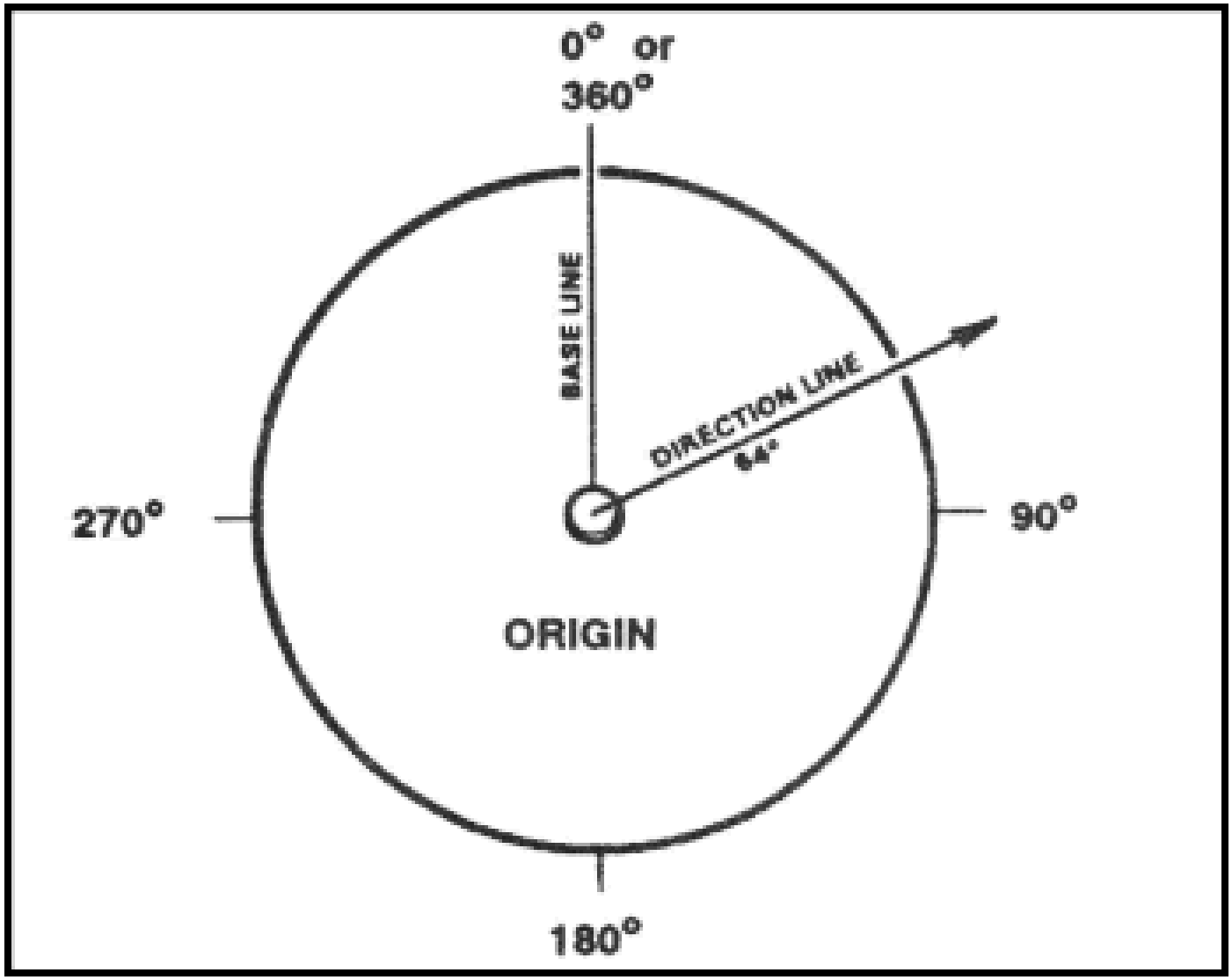
SSTC

3 Norths

Grid North- The north that is established by using the vertical grid lines on the map. Grid north may be symbolized by the letters GN or the letter "y“.

AZIMUTHS

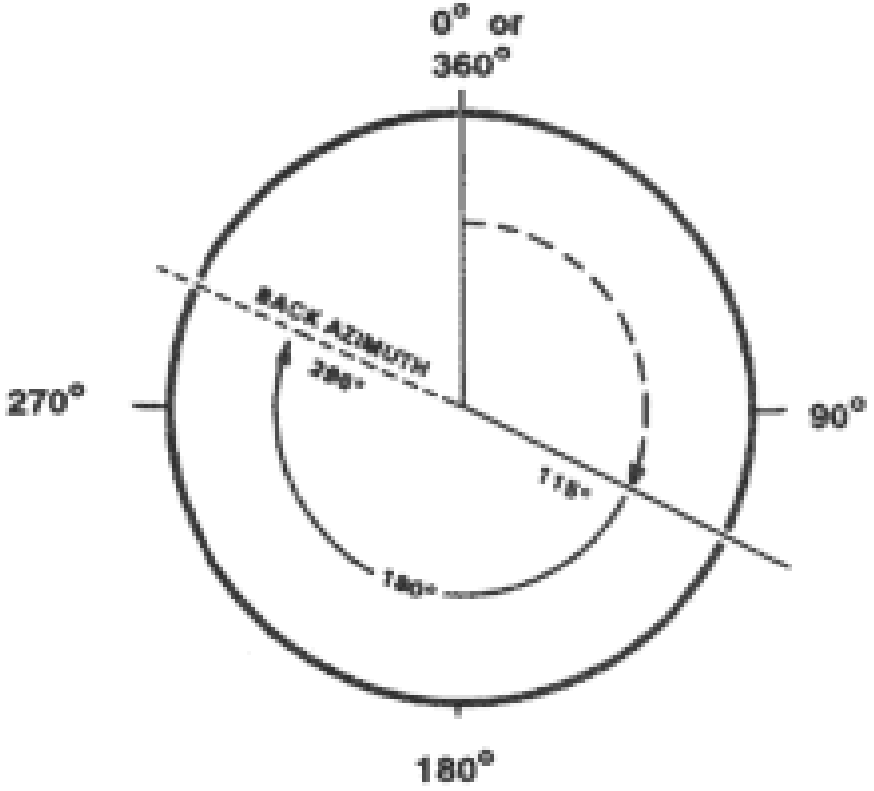
An azimuth is defined as a horizontal angle measured clockwise from a north base line. This north base line could be true north, magnetic north, or grid north. The azimuth is the most common military method to express direction. When using an azimuth, the point from which the azimuth originates is the center of an imaginary circle. This circle is



SSTC

Back Azimuth

A back azimuth is the opposite direction of an azimuth. It is comparable to doing "about face." To obtain a back azimuth from an azimuth, add 180 degrees if the azimuth is 180 degrees or less, or subtract 180 degrees if the azimuth is 180 degrees or more. The back azimuth of 180 degrees may be stated as 0 degrees or 360 degrees.



EXAMPLE:

Azimuth	±		Back Azimuth
115°	+180°	=	295°
337° =	- 180°	=	157°

SSTC

Magnetic Azimuth

The magnetic azimuth is determined by using magnetic instruments, such as lensatic and M2 compasses.